A VISION FOR THE FUTURE OF SUSTAINABILITY AT TU/E
FACILITATED BY THE SUSTAINABILITY CORE TEAM

TU/e

SUSTAINABILITY

TU/e Sustainability Visioning Report

#SustainableTUe

Preface

**"As a society, we have surpassed ecological and social boundaries. Restoring this balance means economic development within its environmental and social limits.
This implies a transition - a radical change in how we fulfill our societal needs. Such a change is multi-actor based. For a university to become a change agent however, it means that it must transform itself. We do this at TU/e by rethinking how we carry out research and education, how we run our campus operations, and how we govern ourselves."**

In an era defined by complex global challenges, the role of educational institutions has evolved beyond traditional boundaries. Universities are not merely centers of knowledge dissemination but also drivers of transformation and innovation. At Eindhoven University of Technology, this understanding has catalyzed a profound journey towards sustainability, one that has sparked reflection, collaboration, and a collective commitment to shaping a better future.

Universities are not isolated entities; they are integral parts of the communities they serve. Sustainability, as a concept, is multidimensional, encompassing ecological, economic, and societal aspects. It calls for holistic and systemic thinking, transcending disciplinary boundaries. This report demonstrates how TU/e should embrace this holistic approach, weaving sustainability into the very fabric of the university - from its educational programs and research endeavors to its governance structures and campus operations.

The Visioning Report on Sustainability is a testament to TU/e's dedication and its readiness to embrace change. As we explore the pages of this report, we will delve into the principles that will guide TU/e on its sustainability journey. We will envision a university where sustainability is not just a goal but a way of life, where students are empowered as agents of change, where research leads to transformative solutions, where the campus is a living laboratory for sustainability, and where governance integrates sustainability into decision-making processes.

Executive Summary

Eindhoven University of Technology (TU/e) is committed to addressing major sustainability challenges and ensuring sustainability is integrated into all aspects of the organization. In response to changing societal expectations and the need for proactive engagement, TU/e has undertaken a comprehensive sustainability approach to ensure that sustainability is interwoven and practiced throughout TU/e's research, education, governance, and it's campus operations.

This process started with the appointment of Anna J. Wieczorek as TU/e's first Sustainability Ambassador, followed by inclusion of Sustainability as the 12th goal in the TU/e Institutional Plan. A Core Sustainability Team has been put in place to work on further institutionalization and integration of sustainability and to help TU/e play a proactive and constructive role in the ongoing processes of transformative change in society. In support of that goal a robust and shared sustainability vision for the University has been developed with a set of guiding principles to support its implementation.

The vision and guiding principles are established with input from a diverse team of researchers, staff, and students who engaged in workshops and discussions to explore desirable futures for TU/e.
This process has yielded the following outcome:

TU/e's sustainability vision
(extract, full version page 14)

Our desired future

By 2050, TU/e fully embodies sustainability and proactively engages with grand societal challenges. TU/e has pioneered transformative education and research for sustainability, created a thriving campus implementing the best regenerative practices, and has successfully mobilized its partners, students, and staff to work jointly in these endeavors.

TU/e strives to help society transform towards sustainability by inspiring others and by supporting future generations of change agents. TU/e applies sustainability principles reflexively across each domain with all members and partners, and does not shy away from making tough decisions.

As a reliable sustainable transformations partner, working ethically and responsibly, TU/e has built a proven track record of co-creating sustainable solutions to society's most pressing issues. TU/e has strong participatory partnership with the public, the City of Eindhoven and society. TU/e's contributes to aiding countries in the Global South by sharing knowledge both locally and internationally.

This general vision is supported by underlying visions including guiding principles per domain. A short extract is provided here. We highly recommend reading the full version in the report.

Research

TU/e's research is farsighted and transformative [1]. In exploring novel solutions to the pressing sustainability challenges, it connects fundamental and normative research. Together with its partners, TU/e forms a vibrant research ecosystem.

Education

TU/e offers inter- and transdisciplinary, engineering education that is transformative [2], holistic, and socially engaged. TU/e trains student to become future change agents.

Campus Operations

The innovative and accessible TU/e Campus fosters regenerative practices in a sustainably thriving, people-centered and experimental environment.

Governance

TU/e champions change in a self-reflective and transparent manner, it mobilizes partners around sustainability to transform industry, government and civil society by offering a safe podium for open and critical discussion.

[1] Transformative research is working with society in a transdisciplinary engagement that focusses on societal challenges in broad partnerships that go beyond industry, balancing out socio- environmental and economic issues by using a systemic approach to change and a stronger focus on impact in our system of research remuneration.

[2] Transformative education enables students to reflect on and foster change in established practices and institutions from the perspective of environmental and social responsibility, enabling them to become agents of change and teaching them competences to tackle the complex societal challenges towards a sustainable society.

TU/e's sustainability guiding principles
(extract, full version page 18)

The guiding principles act as our compass in decision-making, gently moving us towards our destination. A set of 10 foundational principles is developed supporting the overarching aim of TU/e to embrace our responsibility. This implies being pioneering and inspiring, standing up for our challenges, integrating our priorities and mitigating inequalities, mobilizing our resources to act in a consistent, deliberate, hopeful and realistic way while being socially aware and engage our community.

The TU/e Vision and guiding principles offer all members and partners pathways to the future that will either emerge or can be developed. By adopting and working along the guiding principles compatibility with the Sustainable Development Goals is unsured, so is working towards our desired future over all domains of the TU/e. This document also provides a backbone for the Sustainability Core Team in defining base indicators to monitor the transformation TU/e is undergoing.

Final Thoughts

This vision will not work by itself and principles alone are insufficient. TU/e has an extraordinary opportunity to lead by example through meaningful and strong collaboration. Our way of work must change accordingly and sustainability as a holistic and never-ending quest must be embraced. For that process this report serves as a starting point. It expresses the need for ongoing participatory processes to develop a roadmap for achieving this sustainability vision.

TU/e's ambition goes beyond its own transformation to a sustainable organization and campus. By changing the way we educate our students and execute our research we believe we are also able to transform society.

Report Outline

Introduction

TU/e is an internationally prominent university specializing in engineering, science & technology which aims to contribute to the solution of major sustainability challenges. In response to unfolding societal challenges, rapid technological change and changing expectations about the university's role,

TU/e has decided to develop a comprehensive sustainability approach to ensure that sustainability is interwoven and practiced throughout TU/e's education, research, governance, and it's campus. After all, TU/e's motto is 'practice what you teach'.

Sustainability is a highly normative concept that speaks to the aspiration of finding ways of living and organizing our society to meet the needs of present generations while maintaining the integrity of the biosphere and the ability of future generations to meet their needs. Compared to other ideas about how to think about development which emphasizes industrial or economic progress above other priorities, sustainability demands a holistic and systemic approach concerning ecology, economy and society, and the relationships between them (often referred to as profit, planet and people).

How this aspiration is interpreted and operationalized depends on individual and collective worldviews. For instance, the perceptions of our relationship with nature range from anthropo-centric (considering nature in

service for humanity) to eco-centric (considering nature as an equal element to humanity).

The concept also draws attention to various temporal and geographical interdependencies: we take action now, not just for ourselves, but for future generations and ensure that our actions do not have negative implications and impacts elsewhere.

For its pursuit of sustainability, in September 2021, TU/e has appointed a Sustainability Ambassador who has undertaken a 4-step sustainability plan:

1 Establishment
Setting up a structure and institutionalization of sustainability.

2 Evaluation
Sustainability assessment in current education, research, education, and governance.

3 Visioning
Development of a desirable vision and a roadmap to reach it.

4 Execution
Implementation based on ongoing and new initiatives.

As part of the process of institutionalization, in June 2022, sustainability has become a separate 12th goal in the TU/e Implementation Plan.

A team has been set to carry out an assessment of sustainability and the development of a Sustainability Vision.

The basic assumption behind that process is that the university does won't limit itself to reducing its negative impacts but is also seeking to play a proactive and constructive role in the ongoing processes of transformative change in society at large.

The main goal of the visioning process reported in this document was, therefore, to help TU/e develop a robust sustainability vision for the university and institutionalize it.

In that process, we were guided by three questions:
1. Are we following the right principles?
2. What scenarios should we be attentive to?
3. What specific visions should we be guided by?

This document is structured around 4 sections.
Section 1 elaborates on the visioning rationale and process the methods deployed.
Section 2 presents the principles identified by the TU/e community.
Section 3 shows the vision, both generic for TU/e and specific visions for the 4 domains.
Section 4 suggests the next step leading to developing a roadmap.

TU/e's Sustainability Vision

The university strives to anticipate what is necessary to help society navigate transformations towards sustainability and models the necessary practices, inspires others, and supports generations of change agents.

By 2050, TU/e fully embodies sustainability and proactively engages with societal challenges.

It has pioneered transformative education and research for sustainability, created a thriving campus representing the best in regenerative practices, and successfully mobilized its partners, students, and staff to work jointly in these endeavors.
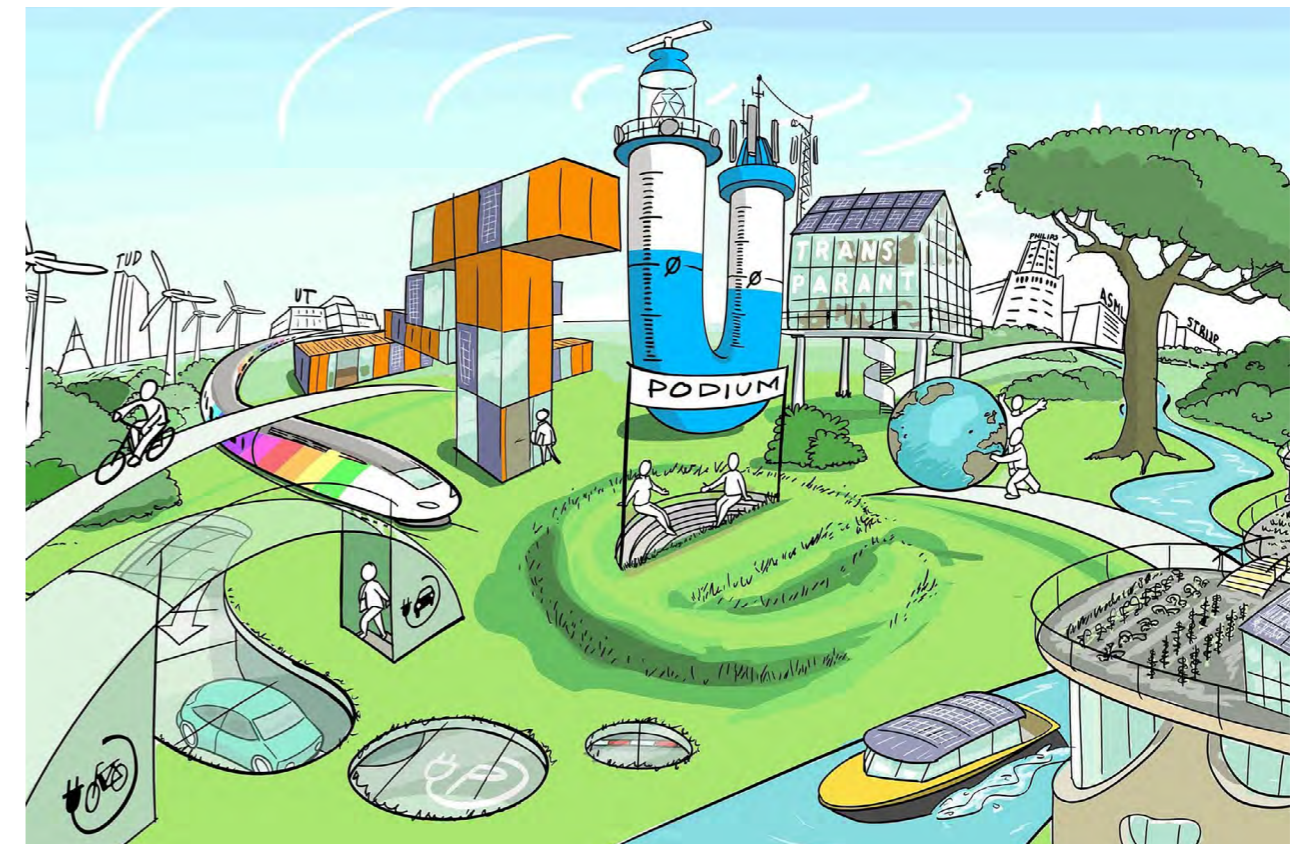
Illustration 1: Overview of the foundational principles, by Helmich Jousma

The university has built a proven track record of co-creating solutions to society's most pressing issues, ethically and responsibly. It is a reliable partner for those committed to enabling sustainability transformations. TU/e contributes to rearranging the economy for sustainability with strong partnerships with the public. It has multiple touching points with the city of Eindhoven and society, inviting the public to participate.

TU/e is not just solving problems for itself but also with and for the countries in the Global South. That way, the university is sharing knowledge both locally and internationally. TU/e is a great place to co- create sustainability innovation.

The university orients itself by applying sustainability principles reflexively across each domain and listening to all its members and partners. It does not shy away from the tough decisions required to do so.

Generic
Guiding Principles

This vision is accompanied by the principles on the right. These foundational principles cut across the different domains.

These principles do not mean that the university has to have all the answers or act rigidly to follow a strict plan. Instead, they demand integrating sustainability and transformation actively in the university's decision-making. Adhering to

these principles would greatly increase the cohesiveness of what the university is trying to do regarding sustainability.

These principles are a start, but more can be achieved with visions of what the university is trying to build. The following sub-sections detail the proposed principles and visions for each domain.
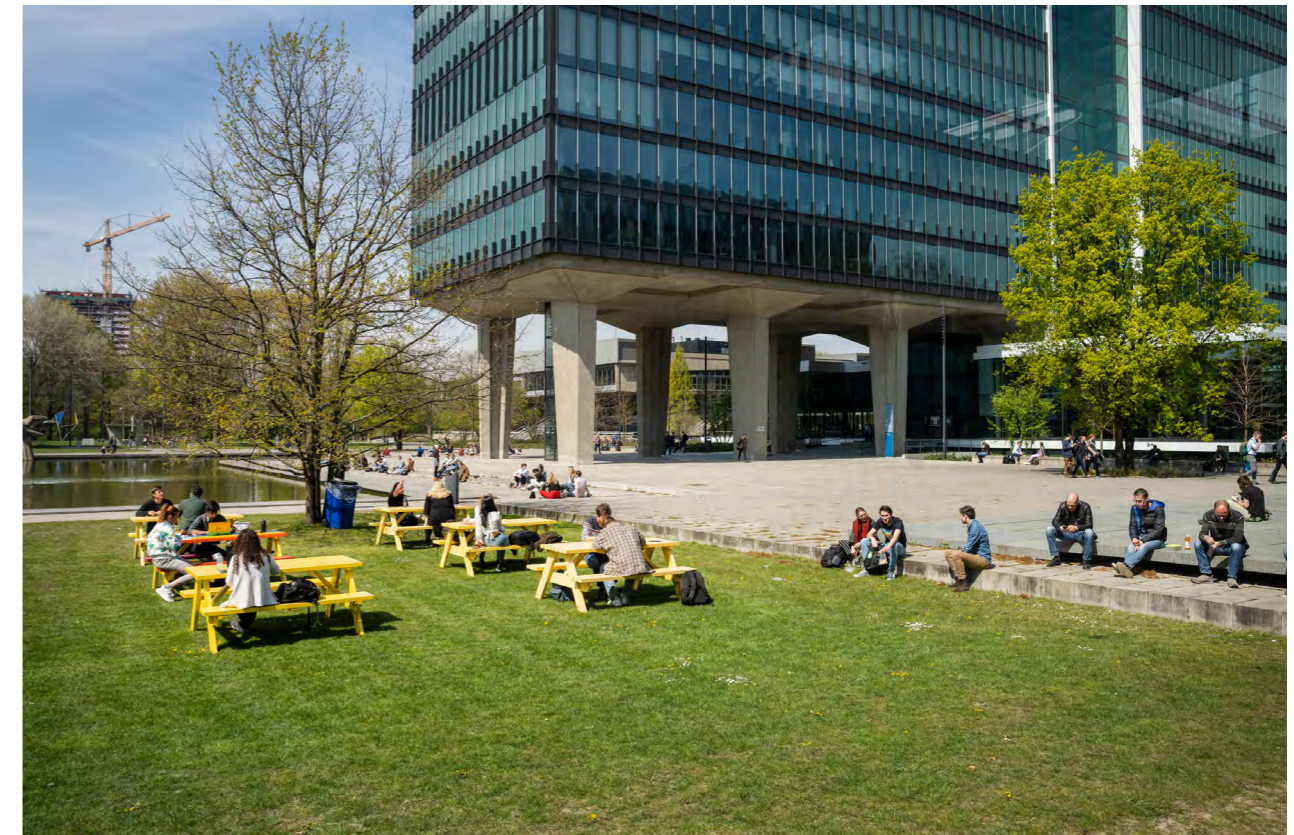
0.0 Embracing Responsibility
TU/e commits to sustainability as a priority and communicates its achievements transparently.

0.1 Standing up for Challenges
TU/e proactively recognizes, anticipates, and acts on urgent environmental and grand societal challenges.

0.2 Consistent & Deliberate
TU/e considers social, economic, and environmental aspects of sustainability in all its efforts and decision-making to have a positive impact.

0.3 Socially Aware
TU/e treats technological development as inseparable from society, considering its impacts systemically.

0.4 Mitigating Inequalities
TU/e strives to mitigate social inequalities and their effects within and beyond the university's boundaries.

0.5 Mobilising Resources
TU/e mobilizes the resources, support and collaborations needed to realize transformations towards sustainability.

0.6 Community-Driven
TU/e fosters safe, vibrant, and diverse communities and collaborative environments where multiple perspectives are welcome and valued.

0.7 Pioneering & Inspiring
TU/e uses its innovations to pioneer regenerative and sustainable futures and inspire others.

0.8 Integrating Priorities
TU/e combines entrepreneurship, diversity, and sustainability efforts to accelerate just and sustainable transformations.

0.9 Hopeful & Realistic
TU/e fosters a collective sense of hope and realism, supporting its communities in navigating the unprecedented

Visions and guiding principles per domain: Educational Vision

'Sustainability is like a language that TU/e students are fluent in'.

TU/e's vision is to educate students as change agents for sustainability, fostering critical thinking and value-based education that benefits humanity and the planet. We focus on technology within a societal context, collaborating with the local community to develop globally informed solutions with local applications. We actively engage with the city and society, promoting transdisciplinary, practical community education and public participation. By sharing knowledge globally, we address sustainability challenges at both local and international levels.

Our engineers possess strong communication skills and a global mindset. They work with local materials, integrate technology into society, and embrace resource limitations through rethinking and repurposing. Students develop self-awareness, take ownership of their personal and professional development, and cultivate entrepreneurial thinking. At TU/e, we frame challenges regarding societal goals, not just technological input. Through challenge-based learning projects, students tackle real-world issues presented by problem owners. We provide creative spaces and facilitate interdisciplinary collaboration, treating our campus as a living lab for innovative solutions.

Our transformative education is supported by teachers who understand complex systems and the implications of technological development. They employ various learning styles, including reflexive and active learning, participatory and transformative learning, and the double-flipped classroom method.

We offer a safe learning environment that encourages critique, reflection, and student involvement in shaping the curriculum. Learners have the freedom to choose courses and explore international opportunities. Our curriculums balance theory and project-oriented courses, promoting interdisciplinary and collaborative learning.

In summary, TU/e's transformative sustainability education emphasizes active learning, collaboration, societal engagement, and a learner- centered approach. We strive to empower our students as agents of change, equipping them with the skills and mindset to address global challenges and create a sustainable future.

Educational Guiding Principles

The illustration shows TU/e students as change agents, that train at the university with (academic) tools and methods (climbing wall) for their lifelong journeys tackling relevant societal challenges. On the training ground, the students can safely explore their visions and opinions (map, juggler). From the TU/e, one is able to view these social and environmental challenges clearly. Students commit to the causes that they feel connected to. This creates multiple pathways, each equipped with mentors that support them in the direction that fits them best.
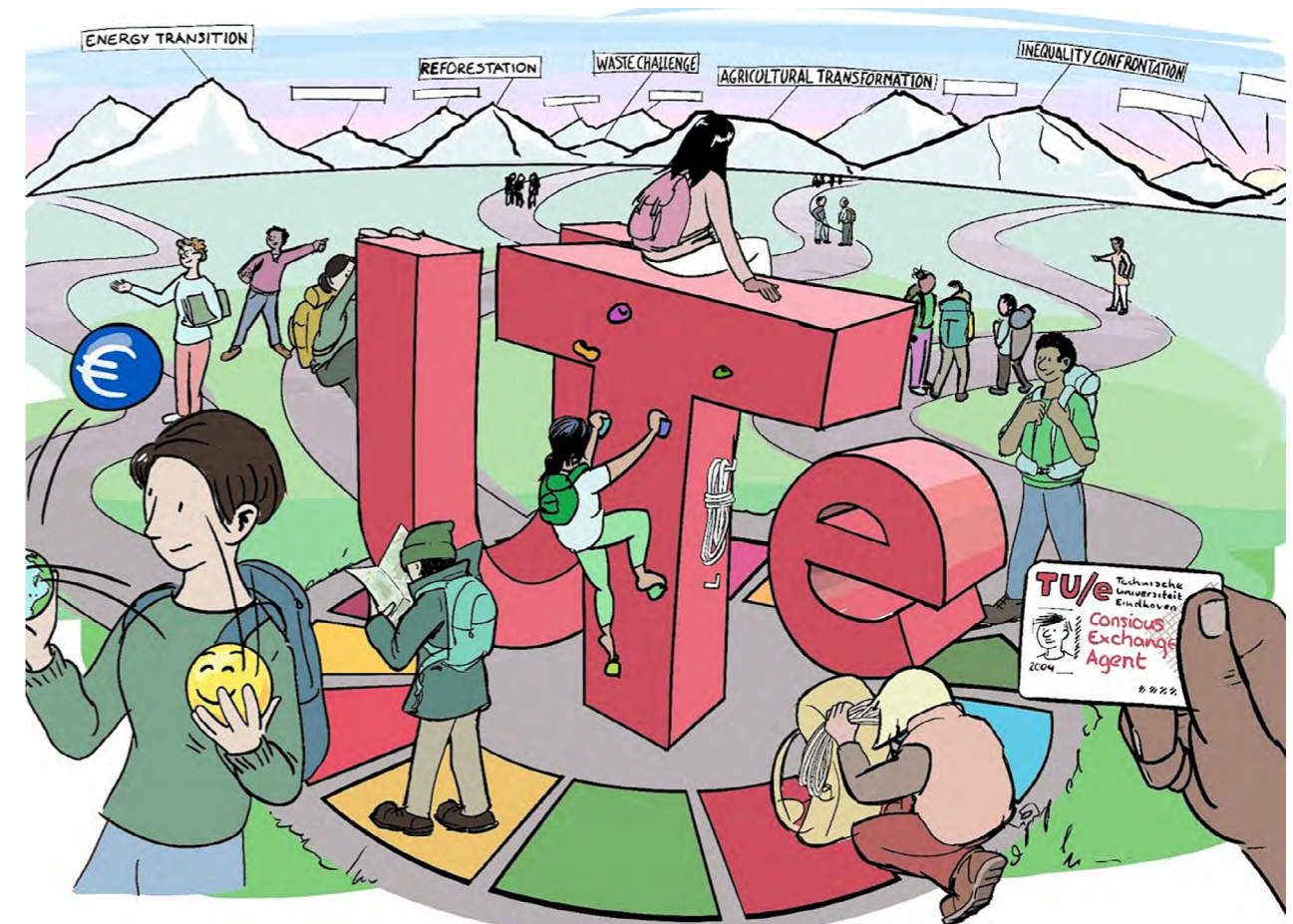
Illustration 2: An alternative vision for education at the TU/e, illustrated by Helmich Jousma.

1.0 Transformative Education
TU/e offers, at all levels, inter- and transdisciplinary engineering education that is transformative, holistic, and socially engaged.

1.1 Cultivating Change Agents
TU/e taps into students' energy and passion, facilitating their growth as individuals, citizens, and conscious change agents.

1.2 Relevant & Up-To-Date
Curricula are continuously updated to meet contemporary and anticipated societal challenges.

1.3 Engaged Students
TU/e collaborates with diverse actors to facilitate students' involvement with societal challenges.

Table 1: Educational principles

Research Vision

At TU/e, sustainability research is the new normal. Sustainability is at the forefront of the university's research agenda and is viewed as a central subject in all departments. The university has helped develop, embed and popularize transformative research to address societal and complex environmental issues. It builds on a long-term and transformative orientation (rather than just optimizing existing systems), as well as transdisciplinary working methods.

Fundamental science, engineering, and innovation work hand in hand. Transformative research draws from and builds on a rich space of curiosity-driven and disciplinary work and doesn't limit itself to high-tech applications. The university is a leader in finding non-conventional and innovative solutions to sustainability challenges and is known for creating a positive transformative impact on society. Instead of solely creating new knowledge, the focus is on filling in the gaps in the existing knowledge, anticipating problems and developing solutions that are adaptive and capable of changing in response to future needs. The university is a sustainability and climate action research hub.

TU/e is well-connected to entrepreneurship, and sustainability is now a core component. The university offers a new business mentoring and advisory service that leverages its expertise and experience to address sustainability issues and maximize external engagement and

impact. This service support entrepreneur and businesses looking to integrate sustainability into their operations and positively impact the environment and society.

The university has transformed into a platform for collaboration, knowledge sharing, and experimentation locally to globally, supported by a world-class campus offering great opportunities to experiment. The university operates as an open innovation campus, with institutes like Innovation Space, where students and researchers work together on systems and setups, blending teaching and research.

The departments have clear goals for sustainability that rely heavily on collaboration, with students working on projects that directly benefit the campus and the local community. The university is connected to civil society. It works through distributed knowledge hubs in the region, with research that fosters locally relevant research (e.g. repurposing and upcycling locally available materials from obsolete products).

Research Guiding Principles

The illustration shows different strands of research at TU/e's campus working together to tackle the societal challenges (represented by the stormy clouds). These increased interactions sustain transformative research for sustainability. Different areas communicate closely but also develop their specific expertise. Actors from other backgrounds also have input (teams and institutes from students or entrepreneurs) and co-create innovative and sustainable solutions. The TU/e shields radical innovation as a "living lab," a secure space for testing and development.
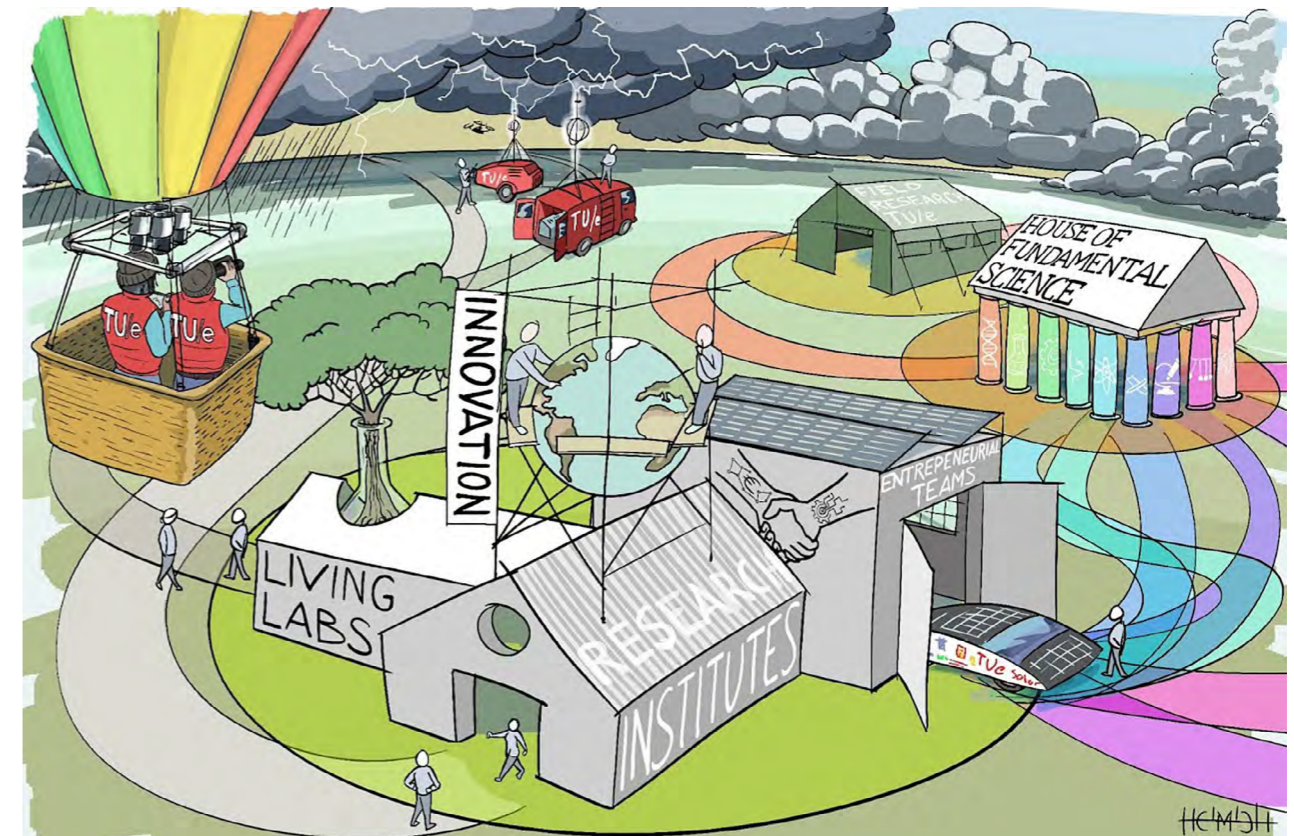
Illustration 3: An alternative vision of research at the TU/e, illustrated by Helmich Jousma.

2 Transformative Research

TU/e values, supports, explains, and disseminates transformative research for sustainability.

2.1 Collaborative & Ready

TU/e and its research partners have ample capacities to engage with various societal challenges.

2.2 Vibrant Ecosystem

TU/e and its partners form a vibrant research ecosystem for sustainability, covering a wide range of perspectives and focal challenges.

2.3 Visionary & Explorative

TU/e's research is farsighted and dynamic, constantly exploring novel solutions and problem framings to the hardest and most pressing sustainability challenges.

Table 2: Principles for the research domain

Campus Operations Vision[1]

[1] In this domain, the university has a well-developed and robust approach to managing and defining strategic direction, and the work of the visioning process complemented that. However, the level of detail of the existing plans exceeds what could be discussed in the participatory settings we created. Hence, the visions shared here are very impressionistic compared to what the university has already adopted and serve mainly to align with the other domains.

The TU/e campus and operations are a thriving and exciting exemplar that embodies sustainability and regenerative practices. These actions are apparent everywhere and to everyone and they are open for feedback. The university is not only trying to reduce its impacts but is embarking on regenerative actions.

The campus is also central to supporting transformative research and education, with facilities for experimenting with sustainable solutions and community-oriented interventions. These allow TU/e staff and students to explore the multifaceted effects of these solutions from a systemic perspective.

The campus and operations also allow the community at TU/e to engage with different imaginaries on how to address societal challenges, e.g. circularity, degrowth, zero waste, car-free, and in doing so, foster a people-centered and realistic approach to making putting those imaginaries to work. The university is increasingly self-sufficient (water, energy, food), and embodies principles that inform other community partners.

Campus Operations Guiding Principles

The TU/e leads by example as an inviting environment with a positive outlook on a sustainable future. All campus users contribute to this through highly- accessible regenerative and circular practices (waste café, reuse shop).

Sustainability is considered the default choice. The campus is enriched with the daily use of the most sustainable (technological) products, systems and services (water capture tank).

Illustration 4: An alternative vision of campus and operations at the TU/e, illustrated by Helmich Jousma.

3 Fostering Regenerative Practices

TU/e is an inspiring example of sustainability, minimizing negative impacts and fostering regenerative practices.

3.1 Thriving & People-Centered

TU/e campus is a thriving space that suits people's needs and meets high standards of circularity, carbon neutrality and zero waste, with a positive environmental impact.

3.2 Innovative & Accessible

The daily life at TU/e embodies the best-emerging practices around sustainability in practical and accessible ways.

3.3 Supporting Experimentation

TU/e's campus is a world-class platform to test, develop and demonstrate solutions for diverse sustainability challenges.

Table 3: Principles for the Campus and Operations domain.

Governance Vision

TU/e's governance integrates sustainability as a norm across its decision- making to continually improve its approach and find ways to mobilize the wider community of partners around ambitious sustainability goals.

TU/e acts as a lighthouse to help other actors orient themselves in the uncharted waters of the years to come. It does so in collaboration with other like-minded organizations whilst creating an open podium for the debates about the different perspectives that concern sustainability and societal challenges.

TU/e is a reliable member of its community that communicates transparently and openly its financial commitments, influences, and lobbying efforts. The university follows its ethical compass to make a positive impact on sustainability. It does so by working closely with partners to remain up-to-date and relevant.

The university works closely with its partners to inspire more ambitious and effective sustainability actions and avoid efforts that undermine society's ability to respond to its challenges. The university is agile and can quickly identify and redress emergent issues.

To ensure the university is moving in the right direction, there is constant monitoring and evaluation of the sustainability strategy using the core principles and revising them over time to ensure the right strategy is followed.

To support its long-term efforts, the university develops a sustainability center with the mandate and funds to conduct cutting-edge transformative research and education that integrates efforts from across the university and creates a critical mass around these issues.

Internally, the university fosters a democratic environment with space for criticism and reflection. The community is involved in decision-making concerning sustainability. TU/e facilitates critical thinking and is not afraid/ embraces criticism as a driver of change.

In terms of impact, the university is concerned with not just making 'a big splash' but having a positive and responsible impact on the world and supporting its staff, researchers, and students. The university is proud of its achievements and communicates accordingly.

Governance
Guiding Principles

The TU/e considers the (long-term) social and environmental implications of board decisions and partnerships (eco-scan and ethical radar) and shares these transparently (window into a lighthouse). The Sustainability Core Team and manager have a clear and objective view of this and the discourse in- and outside of the campus. The TU/e helps its partners steer in a sustainable direction (light beam). TU/e is networked with other institutions within the Brainport, inviting collaboration with non- governmental organizations (lighthouse network).

Illustration 5: An alternative vision of governance at TU/e illustrated by Helmich Jousma.

4 Championing Change

TU/e challenges and mobilizes its partners around sustainability, championing deep partnerships for transformations in industry, government, and civil society.

4.1 Self-Reflexive & Transparent

TU/e evaluates, integrates, and transparently reports the multiple aspects of sustainability to high standards.

4.2 Open & Critical

TU/e facilitates a safe podium for everyone to voice and discuss their opinions and concerns, embracing critical voices and disagreement.

4.3 Sharing Generously

TU/e shares its best practices and learnings widely, helping mainstream sustainability at other organizations.

Table 4: Principles for the Governance domain.

Advice on how to proceed

The visions shared in this document are best understood as recommendations for incorporating the vision into the university's strategy. There are always multiple pathways to attain particular goals (e.g. working towards circularity), so it is necessary to explore these pathways before committing to a particular course of action. Backcasting is central to this and can help define specific actions – and thus construct a roadmap, developing indicators and delegating responsibilities.

Backcasting transition pathways

Since we are talking about a relatively distant future, it will be important to connect it with the current situation in the next steps. This will be done by identifying various pathways and setting intermediary milestones. Keeping openness to this variety is important because change rarely happens according to plan. We also deal with many topics – the sustainability of the campus will develop along a different path than the sustainability of education.

The milestones will be set by means of backward goal setting starting from the far future: 2030 and going backwards to the present day. In that sense, pathways will provide basis for the
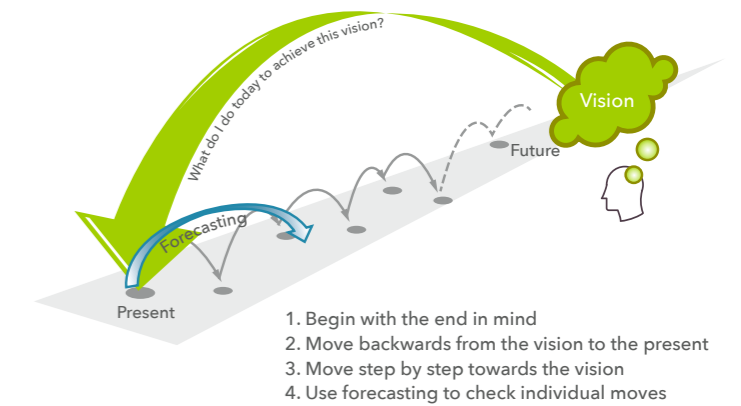

1. Begin with the end in mind
2. Move backwards from the vision to the present
3. Move step by step towards the vision
4. Use forecasting to check individual moves

Figure 1: Backcasting process of relating long-term images to themes and identifying short- term activities, strategies and instruments (Robinson, 1982)

formulation of policies. For example: if we decide to phase out cars from the campus in 2030, then in 2025, we have to reduce their number to 75% and in 2023 to 50% taking current parking occupancy as a baseline. Every such pathway needs to be accompanied by a set of instruments necessary to achieve the milestones and who is responsible (see Figure 1).

The Sustainability Core Team will carry out this process in collaboration with key university stakeholders such as managing directors, policymakers, staff and students. A question to answer in this phase will include: what needs to happen by when if we want to achieve the desired sustainable future at TU/e.
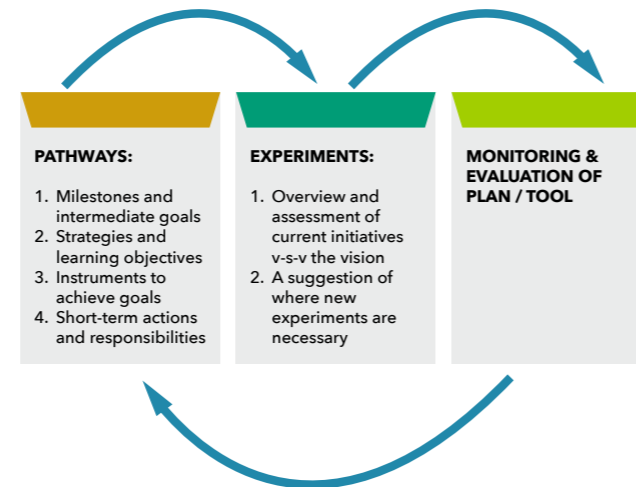
Conducting new and revise ongoing experiments

Experiments are means to test the possible pathways. They embody short term goals, actions and strategies. Many experiments have already been set at TU/e: low-C initiative, ATES, CBL, Living Labs, etc.

These 'emergent' experiments are necessary but must be assessed vis a vis the developed vision, pathways, SDGs. A question to answer here will be: do these initiatives move us ahead in achieving sustainability in a particular field? Do we continue with the projects or do we terminate them and set new ones. This assessment will be carried out in a co-creative way with those already involved.

Evaluating, monitoring, learning and adapting

Since life is changing rapidly, people do too, it is extremely important to ensure that we do not lose the lessons learnt, even if they are negative or when we failed. In fact, these failed lessons is what should be codified in some way for the sake of learning and adjusting. The sustainability team will define basic indicators for monitoring of the process.

The output of the process described above will be the 'TU/e Sustainability Roadmap' including the following elements:

PATHWAYS:

1. Milestones and intermediate goals
2. Strategies and learning objectives
3. Instruments to achieve goals
4. Short-term actions and responsibilities

EXPERIMENTS:

1. Overview and assessment of current initiatives v-s-v the vision
2. A suggestion of where new experiments are necessary

MONITORING & EVALUATION OF PLAN / TOOL

This document would provide a backbone for further work of the Sustainability Core Team in collaboration with other bodies internally at TU/e and externally (in a broader sustainability network).

Methodology

Developing a shared vision is crucial to help TU/e orient its efforts towards sustainability. Visioning is a well-established practice with ample application in sustainability, transitions, and innovation studies debates (REFS).

Visioning allows for the exploration of multiple futures: it is not only about identifying 'plausible' or 'projected' futures based on what, but about engaging with the wider set of probable developments, but also deliberating on what is considered preferable (Figure 2). Each helps inform our decisions in the here and now, e.g. to avoid undesirable developments, direct investments, and initiate changes that lead us towards desirable futures.

On structuring the visioning process for TU/e, our team focused on identifying the desirable futures that the TU/e community hopes to create for the university and in the different domains (education, research, campus & operations, and governance).

For each of the domains, we considered three ways to achieve these desirable futures:

■ Building on what works: TU/e already has set in motion many promising initiatives and policies, and it may be possible to achieve a lot. Recognizing these efforts helps build momentum around promising directions and avoid 'reinventing the wheel'.
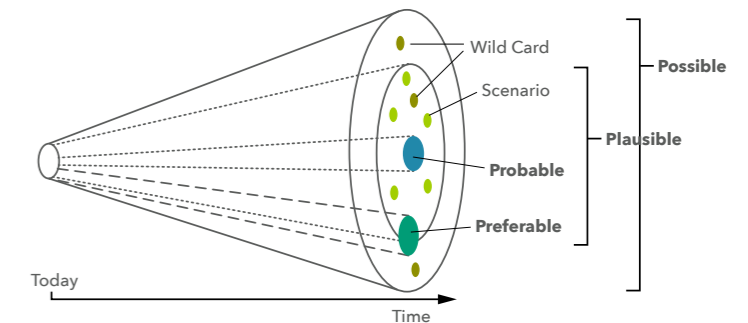
Figure 2: Different futures that a visioning process can help identify

■ Adapting to what's changing: TU/e operates in a constantly changing space, and multiple macro trends deserve our attention. Awareness of these trends helps us maximize our opportunities and avoid disruptive changes.

■ Shaping what is to come: TU/e can anticipate, lead, and proactively shape new opportunities to achieve ambitious goals. This dimension helps us identify and pursue inspiring possibilities while avoiding staying stuck with our current options.

Each way of thinking reveals different possibilities and levels of ambition. Combining the three allows us to develop a more robust vision of what TU/e could do, to envisage opening different pathways towards the future.

Way of Working

To tackle these pathways and the different domains, we assembled a team of researchers, staff and students, combining research and participatory workshops. The team (see acknowledgements) comprised two bachelor students, two master students, a PhD student, two assistants, an assistant professor and an associate professor. It counted with extensive help from the sustainability core team.

The visioning process builds on the idea that it is necessary to go beyond individual (private) visions about desirable futures and try to understand the collective 'imaginaries' (Figure 3).
These collective imaginaries are significant because they are more structured and institutionalized (made into formal and informal rules and habits) and thus go on to shape particular expectation that guides the development of practices, policies, etc.

A dominant' business as usual' imaginary would likely prevail without an intentional effort to consult the TU/e community and facilitate new conversations. By facilitating a participative visioning process, we sought to create space for alternative imaginaries and thus change the (mix of) expectations of the actors within the university. Significantly, the scope of this exercise did not include the 'embedding' of these expectations, as that depends on the formal decision-making processes of the university.

Identifying the different imaginaries of what is desirable that co-exist allows for more informed and intentional decisions on how TU/e can tackle sustainability. The success of this approach depends on a willingness and openness to engage with these ideas. In the workshops, we discussed the future of TU/e, considering 2052 as the year of reference. This is far enough into the future to have space to change but close enough to be imaginable.

Set up of the Workshops

Throughout this process, we invited participants from across the university (staff, students) to have diverse inputs and build a more robust set of visions. We structured the process as a participative consultation structured in different workshops:

Two pilots for testing the approach, with the IEIS-TIS group and first-year bachelor students (ca 80 participants)

The first round of workshops focused on principles and initial visions (alternative imaginaries). (1 and 17 November 2022, n = 51)

The second round of workshops focused on refining and confirming those results, developing scenarios, and revisiting the visions to ensure they were robust and ambitious enough. (2 February 2023, n = 14)

Based on the inputs of the first two workshops, our team developed foundational and domain-specific principles that answer the participant's worries and hopes. Participants were asked to journal about their sustainability experiences, discuss them among groups, and imagine (individually and collectively) desirable futures for that time horizon. We clustered similar observations from multiple participants before we synthesized and logically ordered the principles to avoid repetition.

Our group then revised the principles, integrating feedback from the TU/e community in the third workshop, the launch of the Green Office's Museum of the Future exhibition, and the meeting with the board. Their final wording thus results from multiple rounds of editing by the visioning team, integrating comments from the community to find compelling and clear language that captures participants' perspectives.
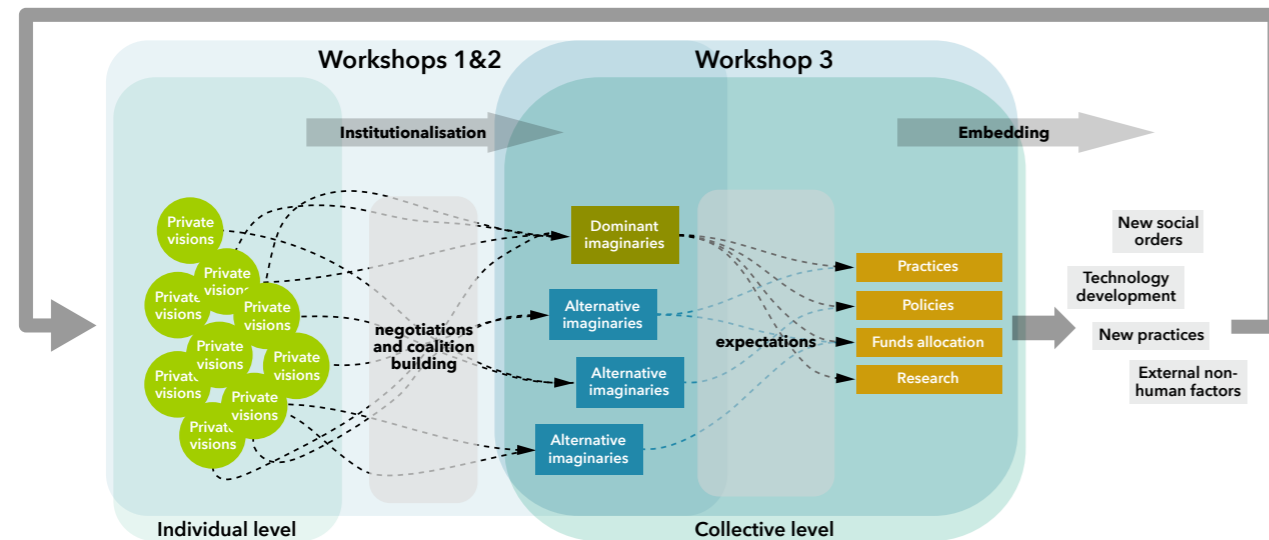

Figure 3: Representation of the approached followed in this project, where workshops were used to identify alternative imaginaries of what TU/e sustainability should be like in 2052. Workshops 1&2 focused on identifying the shared visions and workshop 3 focused on developing those imaginaries further. (See Kerylaine Cristina Assis Magalhães Thesis, based on Rudek 2021)

Niek Lötgerink - BSc in Sustainable Innovation - #SustainableTUe: Building on What's Working and Adapting to What's Changing in Research

Vera Lövel - BSc in Sustainable Innovation - Building on What Works and Adapting to What is Changing: The Case of Transformative Education for Sustainability at TU/e

Alma Vélic - MSc in Innovation Studies- Transformative Education for Sustainability at Universities of Technology: Framework Development and Case Study Analysis of Eindhoven University of Technology

Kerylaine Cristina Assis Magalhães - MSc in Innovation Studies - Sociotechnical Imaginaries of Transformative Research at TU/e (Eindhoven University of Technology)

Anna Shindler - Former PhD candidate - Report on Transformative Research

Box 1: Associated student projects that served as input for this process. The bachelor students focused on the present situation and trends that affect the university. The master students centered on the future visions emerging from the workshops and in individual interviews.

Across these different studies, we collected data of different kinds in this process, which helped us bridge between individual and collective visions (see table 5).

Data	Objective	Mode of analysis
Semi-structured interviews with staff and students*	Understand how the staff is engaging with transformative research and education, and	Open coding to describe the core elements of transformative education and research, and the barriers present at the university
Empathy maps concerning participants perceptions of sustainability	Gauge the worries and hopes of individual participants to provide the basis for establishing	Statements were clustered and summarized. Sustainability principles developed to address these hopes and worries.
Inputs from the participatory visioning workshops	Establish the visions, scenarios, and	All results are summarized in a joint Miro board and distilled into particular visions for each of the domains by the facilitators of the tables.
Survey of participants	Understand the effect of the workshops on participants perceptions, expectations, and engagement with sustainability	Descriptive analytics (see Assis Magalhães MSc).

Table 5: Data collected as part of the visioning process and associated projects

Cultivating a vision

These workshops focused on the domains of education and research, for which less information was available in the group. For campus and operations, and governance, the key managers, Erwin Kerkhof and Lotte Meijer, were directly involved in the group.

The extent to which the principles and visions outlined in this document 'deliver' the desired changes at TU/e will depends on the extent to which the university takes them on and puts them to practice. In the future, more such participative moments would be necessary to develop the road map further. The results are a departure point that can help inform the university's decisions.

To document the tone of the workshops, we also involved two professional illustrators (Helmich Jousma and Ineke Neutelings) whose images help make the visions we discuss more palpable.

These illustrations capture the language and images used by participants to express their perspectives and serve to convey some of the emotional aspects of those images (e.g., hope and optimism). The figures that follow in the report are a result of their work.

The middle part of this report therefore focuses on establishing the principles (which serve as a compass) and the visions (our desired destinations). Still, it requires more specification to define the respective pathways and steps needed to get there. More information about the background research can be found in the research projects of the co- authors, which ran parallel to the visioning process.

Final Thoughts

This report laid out a robust and bold sustainability vision for the Eindhoven University of Technology, developed through workshops and research with the TU/e community.

TU/e could and should become a catalyst for global sustainability transformations. With this report, we envision a future where our university embraces its responsibility and leads the charge, pioneering transformative education and research that transcends disciplinary borders. The university strives to inspire and support generations of change agents and co-create solutions to pressing societal issues, and creates a regenerative campus that serves as a best practice model in the Netherlands, and beyond.

This vision is only possible through meaningful and strong collaborations with the public and private sectors, the city of Eindhoven, and its society. For that, the shackles of business as usual need to be taken off. The aim to collaborate with countries in the Global South emphasizes the importance of not only local, but global cooperation and using local knowledge and each society's needs as a compass in achieving sustainable transformations that go beyond the Sustainable Development Goals.

To help guide the decision-making towards this vision, we have identified a set of foundation principles, and domain-specific principles. These principles compel us to integrate sustainability across all university domains, fostering an environment where diverse voices are heard and valued. However, principles alone are insufficient—we must take bold steps towards their realization.

TU/e possesses an extraordinary opportunity to lead by example and help shape the future. We must embrace sustainability as a holistic and never-ending quest, requiring unwavering dedication and continuous effort. The visions presented in this report are not set in stone, and will not do the work by themselves. Translating these visions into actionable steps, and living by their principles is the next challenge.

Appendix A: Sustainability macro-trends

A key background study informing this report was Vera Lovëi's research concerning the question: What macro trends influence TU/e's ability to conduct transformative education for sustainability? Albeit identified for the education domain, these trends have implications across the university. The following list summarizes those results, with a focus on external trends.

External trends potentially enabling sustainability at TU/e:
- Complex sustainability challenges.
- Unprecedented pressure on decision-makers in government, society, and industry.
- Shift away from reducing emissions & waste towards more comprehensive responsibility within industry.
- Increasing involvement of the private sector in sustainability (including due to greenwashing).
- Move away from dependence on fossil fuels.
- Wide-ranging initiatives, declarations, charters, and conferences surrounding sustainability education.
- General agreement on the need to reform scientific and engineering expertise towards sustainability.
- Changing demands of engineering professionals.
- Increasing and rapid digitization and computerization.
- Shift toward transdisciplinarity being considered a key engineering competence.

- Push towards complexity and holism from a part of the engineering community.
- Scientists increasingly combining academic positions with activism in the public spheres.
- Increasing push from young people toward sustainability.

External trends potentially stifling sustainability at TU/e:
- General shift in learning and teaching methodologies.
- Widespread confusion, disagreement and/ or ignorance surrounding sustainability. Growing polarization.
- TU/e's unfamiliarity with social sciences and humanities.
- Fear of loss of academic credibility for professors teaching interdisciplinary and/or sustainability courses
- Academic recognition still based on research output rather than educational or impact excellent and innovation.
- General overemphasis on environmental aspects of sustainability.
- General disengagement of engineering students from sustainability considerations.
- Lack of integration of meaningful (sustainability) learning processes in HEI systems.

Awareness of these trends, and monitoring of TU/e's preparedness to address them, is central to the continued relevance of the findings in this report.
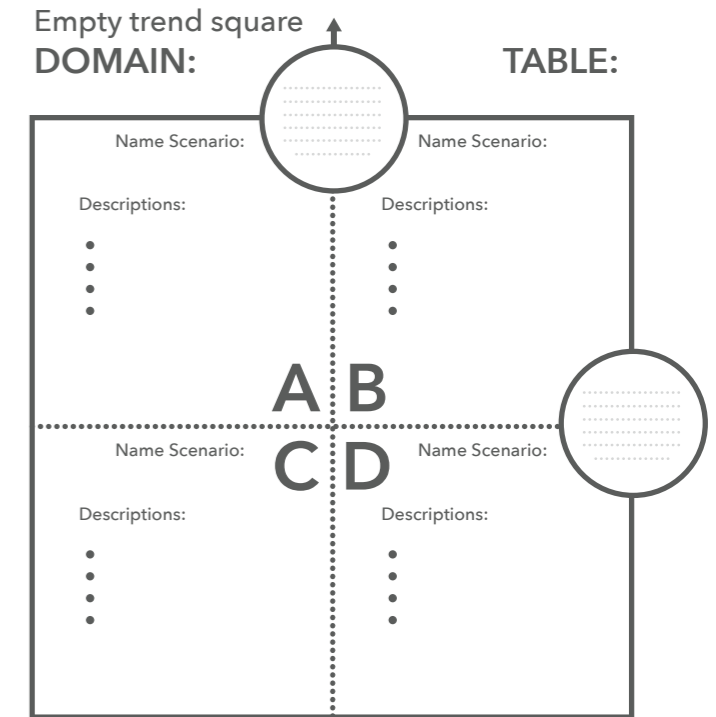
Appendix B: Scenarios

In the third workshop, building on the macro-trends above, participants discussed the probable scenarios that could enable or disrupt TU/e's sustainability efforts. Each group worked coupling two macro trends and exploring their possible combinations, in a two-by- two matrix (figure 4). The following scenarios are a summary of the discussion in the tables. They explore the implications of different macro trends and the uncertainty around their long-term progression.

Education Table

Pairing 'increasing push from young people towards sustainability" (y) and "push from leading companies towards sustainable education" (x)

- Scenario A: Increasing push from young people (low company demand):
  - Students make choices focusing on personal development. Change is slow and incremental; Students' focus varies; they are tired and have their own lives. Executive Board is not very interested as no resources are involved. Development becomes one-sided, following the opinion of most engaged people. Here, ''Conventional courses'' disappear.

Empty trend square
DOMAIN: **TABLE:**

Name Scenario: Name Scenario:

Descriptions: Descriptions:

A B
C D

Name Scenario: Name Scenario:

Descriptions: Descriptions:

WHAT ARE **POSSIBLE IMPLICATIONS** OF THE SCENARIO (A, B, C, OR D)? Define, and name whether positive (+/++), neutral (0), or negative (–/––)

A   **C**

B   **D**

Figure 4: Template used to interrogate likely scenarios by combining two macro-trends.

- Scenario B: Outside stakeholder push (high on both)
  - The main persons of interest are students and companies. The curriculum becomes very hands-on, focused on experiential learning. A bottom-up approach to change: the executive board is informed from the outside and bases its decision on it. Students' choices are also pushed by companies and economic challenges.
- Scenario C: Low push from both
  - No push from students or companies, only societal pressure, e.g., competition with other TUs-TU/e becomes less interesting. The curriculum is not innovative, stays the same.
- Scenario D: High push from companies
  - Companies gain power in university, and students get swayed. The table did not have time to explore the implications

Research Table

Pairing "University embedding in its local ecosystem (x) and "Industry and university are shifting their focus to renewable energy and other sustainable technologies" (y)

- Scenario A: Low embeddedness, shift is happening.
  - Primarily a negative scenario, as the university can help in the shift, giving it substance
- Scenario B: High embeddedness, shift is happening.
  - The most positive scenario: the university contributes to accelerating the shift in society and benefits from it.
- Scenario C: low embeddedness, low shift
  - Worst case scenario, with the lowest level of response to challenges
- Scenario D: high embeddedness, low shift
  - Generally positive, the university works to accelerate shift and pioneer change.

Pairing: "Impact requirements for funding" (y) and "Well-established industry actors inhibiting diffusion of sustainable innovations (x)

- A: low inhibition, high impact requirements:
  - Innovation is largely incremental innovation, dependent on successful research projects, but limited in scope, little substantial improvement.
- B: table did not discuss it.
- C: low requirements, low inhibition.
  - Best scenario – more productive, more innovative. The university is allowed to do risky research, and the industry supports the implementation, with well-defined roles.
- D: high inhibition, low impact requirements
  - Worst scenario: great innovations hidden by industry.

Governance Table

Pairing "disbalance in individualism and collectivism and growing polarization" (x) and "scale jump goes ahead, with higher demand for skilled engineers" (y)

- Scenario A: 'dumb growth or agrowth':
  - Unless scale jump includes sustainability aspects, growth opportunities will not be used wisely and may hinder sustainability efforts. Ambivalent implications.
- Scenario B: 'FIGHT' (high polarization, high growth)
  - Changes to campus and opportunities for more radical innovation, accompanied by high tensions and conflicts forcing choices around sustainability. Greater reliance on private funding creating openings for funders to have more influence. Positive implications for sustainability.
- Scenario C: "Tunnels of diminishing importance" (low vs low)
  - Less innovation or more in disciplines, incremental on small innovation field, less revolutionary, less pressure on the industry around Eindhoven. Negative Implications.
- Scenario D: Polarized status quo (high polarization, high growth)
  - Decisions move away from consensus, with more protests, but speed in the process allow groups to ignore each other. Ambivalent implications for sustainability.
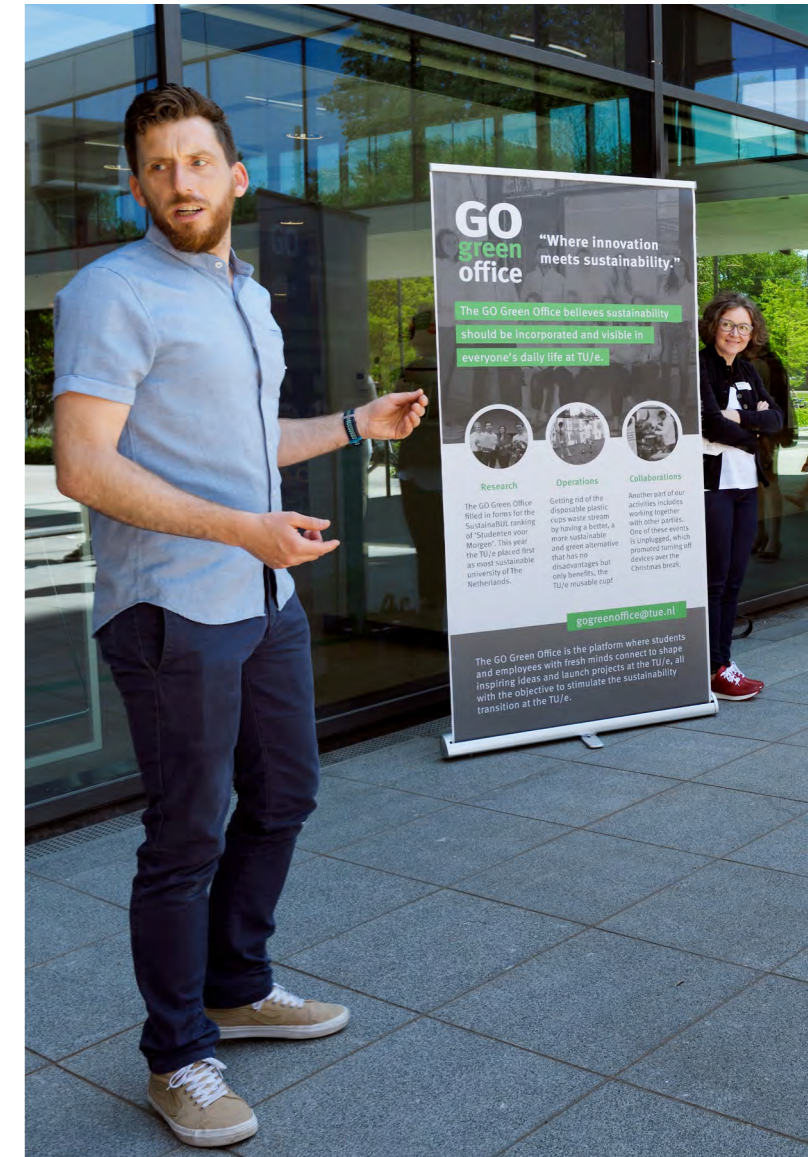
Appendix C: Reflections on the methodology and its limitations

This report outlined the main results of the visioning process.
It is relevant to note the main achievements and limitations of that process.

The methodology employed successfully managed to create relatively nuanced visions and principles that are well received among the participants. Most of the feedback received was positive, with minor suggestions for improvement.

In the MSc of Kerylaine Assis Magalães, the methodology was evaluated with surveys of participants. Table 6 highlights her findings, which suggest the workshops positively influenced the participants interest, inspiration, mobilization, and believe in relation to the possibility of transformative change at the university.

Statements	(S1)		(S2)	
	Mean Scores	Mean Scale*	Mean Scores	Mean Scale*
1 My awareness of TU/e's commitment to sustainability has improved.	3.33	Neutral	3.57	Agree
2 My perception of TU/e's engagement with sustainability has changed.	3.14	Neutral	3.00	Neutral
3 **I became more interested in the discussion about sustainability at TU/e.**	3.48	Agree	3.57	Agree
4 I felt more hopeful about TU/e's sustainability efforts.	3.00	Neutral	3.71	Agree
5 I felt more concerned about TU/e's sustainability initiatives in the future.	3.43	Agree	3.29	Neutral
6 **I felt more inspired and mobilized about TU/e's future possibilities regarding sustainability.**	3.76	Agree	3.57	Agree
7 I felt more optimistic about TU/e's future institutionalized responses regarding sustainability.	2.81	Neutral	3.14	Neutral
8 I felt more confident about the idea that the topic of sustainability can become firmly embedded (a common practice) within TU/e.	2.90	Neutral	3.43	Agree
9 **I believe it is possible to shape the terrain of choices and actions taken about sustainability at TU/e.**	3.71	Agree	4.14	Agree
10 **I believe TU/e can be a proactive change agent capable of inspiring sustainability actions within and beyond the campus.**	3.95	Agree	4.29	**Strongly Agree**

* Mean = 1.00-1.79 (Strongly Disagree), 1.80-2.59 (Disagree), 2.60-3.39 (Neutral), 3.40-4.19 (Agree), 4.20-5.00 (Strongly Agree)

Table 6: Summary of the means scores of perceived responses on the participants' perception after the workshop (question 6) in the first (S1) and second survey (S2) (Assis Magalhães 2023).

Kerylaine's key findings regarding the methodology are:

- "The awareness (1) and perception (2) of TU/e's engagement with sustainability remained mostly neutral.
- Workshops are a way to develop individuals' interest (3) in sustainability further.
- People felt more hopeful (4) and less concerned (5) about TU/e's efforts.
- Workshops can inspire and mobilize (6) groups to collectively create imaginaries.
- Optimism (7) and confidence (8) regarding the institution drastically increase when the workshop feels closer to concrete action.
- Shared beliefs (9) (10) are the key to understanding shared visions."

The main limitations concerning the visioning methodology noted in that study are:

"Despite attempts to recruit diverse individuals, logistical and scheduling constraints resulted in a limited number of attendees.
This constraint may have impacted the study's ability to collect a representative, diverse, and robust sample.
Additionally, the participatory visioning process did not provide an opportunity to engage with individuals and groups who are less receptive to sustainability initiatives. As a result, the workshops predominantly included sustainability-minded individuals who were enthusiastic about the collaborative visioning process.
Consequently, the absence of critical perspectives may have resulted in a partial representation of the TU/e community's views. This limitation may hinder the findings' generalizability and the visions' applicability to other contexts." (Assis Magalhães, 2022, p.55)

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