Study Guide 2019-2020:
Education for Global Sustainable Development at TU/e

Eindhoven University of Technology
University Committee on Technology for Global Development
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TU/e Master of Science certificate: ‘Technology for Sustainable Development’ (TSD/MSc)

Certificate courses ‘Technology for Sustainable Development’ (TSD/MSc.)

0EM140 - Energy, economy and society
0EM150 - Sustainability Transitions and Responsible Innovation
0EM200 - International Development and Sustainability
0EM310 - From industrial ecology to sustainability assessment
0HM260 - Environmental Psychology
0LM130 - Ethics and the risk society
1CM170 - Sustainable supply chains
1ZM150 - Innovation Space project
4EM70 - Sustainable energy sources
7QW3M0 – Urban Planet

Other Master courses relevant to Technology for Global Development

0EM110 - Research Methodology for the Innovation Sciences
0EM170 - Global Connections
0LM150 - Entrepreneurship and Corporate Social Responsibility
3MP110 - Solar cells
4AT020 - Clean Engines and Future Fuels
4GA50 - Solar heat system
5LEB0 - Environment and power engineering
7LS3M0 - Sustainable buildings/ physical aspects of building materials
DCM130 – Design for Social Innovation

PhD & PDENG Courses relevant to Technology for Global Development

OPDE05 - Innovation Camp: Bootcamp for transformative approaches to energy, mobility and smart cities
Dear Student,

With great pleasure, we present the 17th edition of the Study Guide for Development-related Education at the Eindhoven University of Technology.

This Study Guide provides an overview of the courses, offered by TU/e in the year 2019-2020, which directly or indirectly address global sustainable development and the Sustainable Development Goals. The students are encouraged to engage with technological, social and environmental issues arising from unequal power relations, inequality and exploitation of people and resources.

This study guide has the latest course information from Osiris 2019-2020. Information on internships and MSc projects will be made available on our website (in the education section), and at the yearly organized TGD Goes Abroad event.

In addition, TU/e offers for Bachelor students the USE Learning Lines ‘Responsible Innovation in a Global Context’, and ‘Design for a sustainable future’. More information can be found in this study guide and on the tue education guide.

For Master students, there is a certificate program in Technology for Sustainable Development, 20 ECTS. More information about these Certificates can be found in this study guide and on the tue education guide.

If you are interested in meeting other TU/e students and staff with an interest in technology for sustainable global development, then read our introduction on the University Committee Technology for Global Development (TGD) in this guide or on our website and participate in our activities including symposia, workshops, hackathons, lectures, film-screenings etc..

We hope this Study Guide will inspire you and help you find the TU/e courses of your interest!

Mariëlle Besling-Dullaert
Coordinator of the University Committee Technology for Development (TGD)

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1. University Committee Technology for Global Development (TGD)

What is TGD?

Technology for Global Development (TGD) is an interdisciplinary organization where students, teachers and researchers raise awareness about the socio-economic and environmental challenges of the present, to inspire the TU/e community to create, design and implement innovative technological solutions for global sustainable development. While having a focus on developing countries, TGD believes in the systemic interrelationship between actors around the world.

Why TGD?

In 2001, a group of students, moved by the concern about the declining interest in development issues, drew up the “Technology for Development” manifest. This manifest states that Technological Universities are uniquely equipped, and have an ethical obligation, to contribute to the implementation of technological solutions to alleviate poverty, address social justice and improve people’s living conditions in developing countries. The manifest was signed by no less than 1500 students and staff and the Board of the University instituted Technologie voor Ontwikkeling (TvO) University Committee. TvO’s name was later updated to the more international name of TGD.

Eighteen years have passed, and this mission is more relevant than ever. Despite growing inequality and urgent global challenges, the potential of the TU/e community remains largely unattended. In a situation of growing inequalities and urgent global challenges, it is impelling to foster the realisation of potential within the TU/e community to contribute with innovative solutions to the Sustainable Development Goals set out by the UN.

Thus TGD’s vision is to educate; raise awareness; encourage critical discussion and action; create connections; and form scientists and engineers that can bring change and contribute to global development.

Access to electricity promotes girl child Education and gender equality.

Photo: Anil Kumar, India
TGD’s focus

Many of us are concerned with the global problems of today, such as climate change; armed conflicts and terrorism; scarcity of energy, water and food; lack of education; poverty and social exclusion; deadly diseases and inadequate health systems. In developed countries these issues receive the deserved attention especially through the important role that scientists and engineers play by making use of the latest advances in technological knowledge. However, in developing countries, forming the largest part of the world, there is a dire lack of local technological capacity and resources to develop locally appropriate solutions to these problems.

Beyond these distinctions, it is clear that nowadays global challenges, such as climate change, require an approach that transcends these boundaries. Cooperation between scientists and engineers and sharing of knowledge and resources across the world is fundamental to address these issues.

Combining vernacular knowledge and technologies with western knowledge and resources can be very fruitful. Western inputs can range from relatively simple, low-tech solutions to high-tech innovations at the frontier of global knowledge. Varied as these inputs may be, what they all share is the requirement of effective support based on knowledge of local circumstances and needs, and close cooperation between local and foreign stakeholders.

How does TGD work?

The TGD Activity Committee organizes activities on the theme of technology and development for the TU/e community. Events range from lectures, hackathons, cultural days, workshops, career events etc, also in collaboration with other institutions such as TINT, Studium Generale, Engineers Without Borders, etc.

Another main focus of TGD is to promote fieldwork in developing countries, by presenting to students opportunities for thesis projects and volunteering and by assisting them in finding funding.

The Activity Board is run by students and is always open for new members. If you are interested, you can send an e-mail to TGD@tue.nl or come talk to us!
2. TGD Activities 2018-2019

February 2  
Workshops and Lecture: ‘Disaster into recovery’

February 7  
Lunch lecture: ‘Bambu Social’

March- September  
Exhibition: TGD Photo Competition, Metaforum

March 20  
Internship Workshop; TGD Goes abroad

April 25  
Info-lunch Lecture: ‘Responsible innovation in a global context’

May 2  
TGD and Cosmos Movie Night; ‘Before the flood’

May 24  
Lunch Lecture: ‘One world Citizens’

June 1  
Indonesian Cultural Day

August  
Intro Week Activities

September 18  
TGD Info Lunch

October 3  
Agri-Drone Hackathon

November 16  
Lunch Lecture: Transformative Policy

December  
Annual Photo Competition

December 12  
Christmas Market Stand

December 17  
End of Year Celebration with OWC and Tint

February 19  
TGD Summer Action

February 26  
TGD Goes Abroad

May 8  
TGD Info Lunch

March- September  
Exhibition: TGD photo competition, Metaforum

June 4  
Indian Cultural Event

Furthermore, TGD supports development-related student-projects in developing countries (facilitation of internships abroad, international programs, symposia and fora, volunteering etc.).

Follow us for upcoming events:
3. Who runs TGD?

TGD Daily Board

Prof.dr.ir. E.J.E. Cottaar (Chairman)
Dr. Henny Romijn (IE&IS)
Dr. Johanna Höffken (IE&IS)
Ir. E. Hendriks (B)
Ir. Ivana Abramovic
Mariëlle Besling (Secretary)

Student members:
Ana Xambre Pereira
Giacomo Pimpini

TGD Activity Committee

Ana Pereira (Chairlady)
Giacomo Pimpini (Chairman)
Yavor Razboinikov (Secretary)
Anil Kumar
Eileen Moree
Ramona Pukhamer
Ruben Lathuy
Ananya Mehrotra
Hamshini Suresh
Janarthanan Karunakaran
Limi Kalapurackal
Nina Weicherding
Zafina Aminuddin
Rhythm Poddar

TGD Advisory Board

Prof.dr.ir. E.J.E. Cottaar (Appl. Phys.) (Chairman)
Dr.ir. Arjan Frijns (Mech.En)
Ir. Monika Roeling (ESA)
Drs. Marleen G. van Heusden(IE&IS)
Ir.ing. Dione van Noort (Mech. En.)
Prof. dr. Fausto Gallucci (Appl. Phys.)
Dr. T.W.A. Schröder (B)
Beatrijs van der Hout (EE)
Dr. Esmaeil Najafi (EE)
Mariëlle Besling (Secretary)
4. Fieldwork in the Global South

Students who are interested in doing fieldwork in a developing country can participate in ongoing TU/e research or external projects in the form of an internship or MSc thesis project. TGD collects and shares information with students regarding internships/research during the TGD Goes Abroad fair, which takes place in February. Around the same time also TGD Summer Action takes place, an opportunity for students to find out about volunteering and interning opportunities.

On the next page you can find examples of student projects in developing countries.

TGD Fund

TGD offers TU/e students the possibility to apply for a max. €500 fund as financial support for a research/project taking place in developing countries as part of their studies. The research has to focus on technology in relation with its socio-economic context and has to be enriching for the TU/e community. For criteria and deadlines, consult our website.

Other sources

Furthermore, information about fieldwork is also available on:

- Ministry of Foreign Affairs
- AIESEC
- Stagelopen in het buitenland
- Wilweg

For financial support see:

- TU/e Grants, Funds and Scholarships
- Beursopener van Nuffic
- Students for Sustainability (S4S)

Reports from students who did an international semester, internship or MSc- project abroad can be found on the TU/e page in the education guide at ‘broadening’, and on the website of TGD

Contact TGD in case you are searching for fieldwork opportunities or you need financial/logistical support!
## 5. Examples of student projects in the Global South

**Growing influence of SMGs in rural India**

A case study on Gram Oorja Solutions PVT. LTD.

The Indian company Gram Oorja has a unique model of rural electrification where they incorporate community participation and bottom-up approach of governance for the effective implementation of their projects in rural hamlets of India. **Anil Kumar** and **Arpan Sen** visited India to conduct several interviews and site visits in Gumla and Khunti district of Jharkhand, India under the supervision of Gram Oorja Private Ltd. They studied the social impacts of energy access in rural India and assessed the direct and indirect benefits of Solar Microgrid (SMG) Installation, under the Gram Oorja model of rural electrification.

**Students assembling a wind turbine (Indonesia)**

**Mariana Tapia** and **Alice Consolaro** conducted a joint internship in Indonesia in 2018, where they evaluated an international aid program carried out by the TU/e during 2009-2011. The program, called CASINDO, was aimed at improving the quality of teaching, research and policy support capacities of staff of five Indonesian universities in the field of renewable energy. Three of these universities could be visited, and their staff and students were interviewed to assess project outcomes and long term developmental impacts. Several positive effects were observed relating to curriculum development on renewable energy topics, use of equipment in teaching and research, and staff involvement in policy advisory work.

**Micro hydro electricity system on Java (Indonesia)**

Premature failure of government-constructed rural microgrids is a big problem in Indonesia. **Milou Derks** devoted her internship and graduation project in 2018 to an investigation of the reasons for this. She was hosted by Universitas Mohammadiyah Yogyakarta. Structural neglect of post-installation maintenance and repair, and lack of attention for local capacity development among rural communities were immediately apparent. But upon closer inspection these problems were found to derive from adverse incentives faced by project stakeholders, linked to structural governance problems in the Indonesian government.
6. MSc. theses in the field of Technology for Global Development (from the department of IE&IS)

2019

19.01 Merlijn Borneman: An investigation of the sustainability trade-offs of the cocoa supply chain connecting the Netherlands with the main and most interesting cocoa supplying countries (Ghana, Côte d'Ivoire and Ecuador) between circa 1975-2015.

2018

18.07 Jeroen van Hemmen: Governing Rural Waste - A case study to the implementation of the eight design principles to solid waste management in Bali

18.06 Milou Derks: Challenges for Sustainable Performance of Government initiated Rural Microgrids Analysis of Incentives and policy framework for Indonesia

18.05 Jaara Bijvoet: Energy access for enterprises in developing countries Exploring the role for renewable energy technologies to address the energy issues in Kenya

18.04 Dion Visser: Sorting it out: An analysis of waste management provisions and realities on Bali

18.03 Micky van Gemert: The Influence of contextual factors on “last-mile” distribution models for solar home system distributors in East Africa

18.02 Santiago Angel Nieto: Barriers and solutions to scale up green microfinance, Insights from a case study in Colombia

18.01 Mercedes Fuentes Velasco: Use of Mangrove Wood as a Raw Material for Renewable Energy; Case Study on a Small Island in Indonesia

2017

17.08 - Britte Bouchaut: Rural Sanitation Facilities and Quality of Life: A mixed methods analysis of the contribution of Safe Water Gardens to the Quality of Life in Bintan, Indonesia

17.07 - Benedicte van Houtert: Cultural differences hampering turning e-waste to gold in Africa: Intercultural cooperation for sustainable handling of e-waste in sub Saharan Africa

17.06 - Arturo Daniel Salinas Galvan: Drivers of Stove Stacking in the Cooking System: A case study on the Adoption of Advanced Clean Cookingstoves in Northern Vietnam

17.05 - Muhammad Husni Mubarok: Capacities and Accountabilities of Stakeholders in Indonesia’s Rural Electrification Program. A view from Responsible Innovation and Learning Approaches.

17.04 - Laura Wong Sagel: Women interaction with biogas technologies in rural areas. A case study in Narino and Huila, Colombia

17.03 - Jiayi Zeng: When micro-grids meet the central grid: The emergence of grid interconnection as innovation to address the reliability issue of rural electrification

17.02 - Ana Gabriela Dávila Gavilanes: Feasibility Analysis of Electric Road Transportation. Introduction in Santa Cruz, Galapagos Islands.
17.01 - Ellen Hoefsloot: Buying into the Kenyan solar market; Exploring user perspectives on investing in solar electricity

2016

16.05 - Mutia Prabawati: Sustainability of rural electrification projects: Case Study of Private Sector Intervention in Indonesia.

16.04 - Si Liu: Jatropha Biofuel Development in Cultivation And Processing In China from 2007 to 2012: A Field Study.

16.03 - Rodrigo González López: Identifying enabling and hindering factors to design better business models for rural electrification: Rural Uganda case study.


16.01 - Joaquin Corella Puente: Augmenting the SNM framework as a practical tool for sustainable innovation in the South. Design and implementation of technologies for small-scale farmers in Northern Mexico.

2015


15.02 - Mara van Welie: NGOs’ transformative approaches. Exploring how Cordaid can contribute to a fundamental change of the sanitation system in urban informal settlements in low-income countries.

15.01 - Peter Kuin: No view from nowhere; studying diverging stakeholders’ framework to reduce conflict over water resources in Loitokitok
7. TU/e courses relevant to Technology for Global Development

Here you can find all courses related to TGD’s mission, organised by course type (Bachelor, Master, etc.).

Moreover, you can find other relevant courses offered by other Dutch Technical Universities on their websites and course catalogues:

- TU/e Delft Global Initiative Education
- Wageningen University - (Bachelors) (Masters)

8. Bachelor courses relevant to Technology for Global Development

**0SV00 - Sustainable development in a global context**

**Description:** This course introduces students to the concept of 'sustainable development' in a global context. Over the last four to five decades, this concept has become increasingly visible in global and regional policy, business and academic agendas. Students will learn to study ecological and socio-economic development of nations, regions and communities across the globe as integrated challenges.

**Provided by:** Bachelor College, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 1 – Timeslot D

**Responsible Lecturer:** dr. J.J. Höffken

**0SV10 - Sustainable Technology in Society: Introduction**

**Description**

The Technology in Society learning line teaches SI students how technology and society are intimately interwoven. As an introductory course, 0SV10 introduces SI students to:

1. basic concepts and theories about society (such as: social groups, progress, conflict, etc.);
2. the intertwine of sustainable innovation with social, political and ethical issues (basic introduction to the discipline of STS);
3. the holistic study of innovation as a sociotechnical process in a specific time, place, and stakeholder setting (students learn to 'follow the process');
4. tensions and controversies between stakeholders and ways how to analyze them

**Provided by:** Bachelor College, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 2 – Timeslot C

**Responsible Lecturer:** dr.ir. F.C.A. Veraart
0SV80 - Sustainable Technology in Society: Advanced

Description: STIS Advanced acquaints students with selected advanced research debates that all sustainable Innovation students should know about. These include e.g. current research debates on the Anthropocene, just transitions, global sustainability telecouplings, sustainability knowledge politics, and responsible innovation.

Provided by: Bachelor College, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 1 – Timeslot D

Responsible Lecturer: prof.dr.ir. E.B.A. van der Vleuten

0SV20 - From industrial ecology to Cradle-to-Cradle: mass flow based concepts

Description: In this course we will focus on mass flows: natural mass flows (elemental cycles, including the carbon cycle); flows through the industrial system and their environmental impact (materials, processes, products); and flows at a more aggregated level (product chains, sectors, compartments or complete economies). We will present basic concepts and data, and explore and apply analysis tools and critically reflect on them. As such, the course is interesting for anyone involved in production, chemicals, building or energy.

Provided by: Bachelor College, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot B

Responsible Lecturer: dr.ir. A.F. Kirkels

0SV40 - Managing Sustainable Technology

Description: Drawing on insights from the field of sustainability transitions, innovation sciences and STS (Science and Technology) studies, Managing Sustainable Technology course introduces students to the possibilities and constraints of how societies can manage innovations. Given the limitations of product and process innovations in dealing with grand societal challenges such as climate change, poverty or social inequalities, this course focuses on innovation from a system perspective.

Provided by: Bachelor College, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 1 – Timeslot E

Responsible Lecturer: dr.ir. A.J. Wieczorek
0SV50 - Managing Sustainable Technology–OGO

Description: During the course students learn to practically operationalize insights and tools from the field of Science and Technology Studies and apply them to a "real life" sustainable innovation process/project/case. The OGO project builds upon the course Managing Sustainable Technology (MST). In short, this course is set out to put "MST theory" into "OGO practice". Consequently, students, split up in groups, will choose one case study (related to topics such as energy, ICT or mobility) in order to study how technology is/can be managed in society and design policy or strategy recommendations based on their analysis.

Provided by: Bachelor College, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 3– Timeslot E

Responsible Lecturer: dr.ir. A.J. Wieczorek

3DEX0 - Physics of energy: sources, transport and storage

Description: This course covers fundamentals of thermodynamics and of conversion-storage processes applied to (renewable) energy systems. Topics include analysis of energy conversion in thermomechanical, electrochemical and photoelectric processes in existing and future power systems, with emphasis on efficiency, present status and potential. Focus sessions, following the fundamentals of thermodynamics, include: electricity generation from photovoltaics and wind energy; hydrogen and solar fuel productions, fuel cells and battery storage.

Provided by: Bachelor College, Applied Physics

Credits (ECTS): 5

Planning: Quartile 2 – Timeslot E

Responsible Lecturer: prof.dr. M. Creatore

4EC10 - Dynamics of energy systems

Description: The course concerns modelling and analysis of practical thermal systems and concentrates in particular on unsteady and/or nonlinear behavior. Relevant examples include thermal comfort in humans, thermal management of micro-electronics and transient behavior of turbomachinery. Topics:
- Modelling of unsteady thermal systems by the conservation laws.
- Dynamic thermal interaction by conductive, convective and radiative heat transfer.
- Numerical modelling and simulation of flow and heat problems.
- Dynamic analysis of unsteady systems.

Provided by: Bachelor College, Mechanical Engineering

Credits (ECTS): 5

Planning: Quartile 3 – Timeslot A

Responsible Lecturer: dr.ir. M.F.M. Speetjens
DCB170 – Socio-cultural Sensitivity

Description: Products have a lot of functions. They need to fulfill the practical function that they are designed for, need to be durable, save to use and aesthetically pleasing. Yet next to these more or less objective functions, there are a whole lot of more subtle functions and meanings. This elective is dedicated to these more subtle functions and meanings of products. Through the combination of theory and practice we aim to develop sensitivity for the sociocultural aspects of design. More specifically, you’ll be introduced to the role of ethics, sustainability, history and interculturality in relation to design.

Provided by: Bachelor College, Industrial Design

Credits (ECTS): 5

Planning: Quartile 2– Timeslot A

Responsible Lecturer: dr. J.M.L. Kint

DCB210 – Intercultural Design

Description: As a designer you need to be aware of the different roles, values and (sub)cultures of the people you are working with, especially now participation is getting more and more important in design when addressing societal challenges. And because designing for societal challenges is complex, it requires many points of view and collaboration and participation. This course will help you to discover your own values, what theory could help you with discovering others and how this influences e.g. the work ethics, company culture, design briefs and your way of collaborating. This course is a must for those who want to prepare for an international exchange, internship or working in complex multi-stakeholder environments.

Provided by: Bachelor College, Industrial Design

Credits (ECTS): 5

Planning: Quartile 4– Timeslot A

Responsible Lecturer: C.L. van den Bremen
9. USE Learning Lines relevant to Technology for Global Development

USE Learning Line: Responsible Innovation in a Global Context

In the Learning Line Responsible Innovation in a global context you will learn how to develop responsible innovations that are tailored to global contexts. In doing so, you will be introduced to a set of concepts and approaches that you will use in the design and analysis of your innovative ideas/project/product.

How is it organized?

Throughout the 3 quartiles you will work in groups in the Innovation Space on concrete innovations. In your design-work you will be supervised and accompanied by a team of TU/e’s academic staff and social entrepreneurs and business leaders from the private and public sector. The overall aim is to design responsible innovations that make a meaningful difference in the lives of people that live in the global south.

The total course load of the USE learning line is 15 ECTS, for further information please look at the website.

USE Learning line coordinator:
Dr. Johanna Höffken
TU/e Atlas Building North 8.414
J.J.Hoffken@tue.nl

Course planning 2019-2020

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<td>Q1</td>
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<td>Q3</td>
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<td>0SEUD0 Responsible innovation in a global context – Context Matters! (5ECTS)</td>
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<td>0SSUI0 Responsible Innovation in a global context – Make it matter (5 ECTS)</td>
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<td>0SAUG0 Responsible Innovation in a global context – External matters! (5ECTS)</td>
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**0SEUD0 - Responsible Innovation in a Global Context-Context Matters!**

**Description:** Quartile 1’s motto is: context matters! You will see how and why context matters, if you want to successfully develop responsible innovations.
From the very beginning you will engage in the design of a responsible innovation project. This engagement is supported by theoretical insights and inspirations you receive during lectures (“power hours”).

**Provided by:** Bachelor College, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 1– Timeslot A

**Responsible Lecturer:** dr. J.I. Höffken

**0SSUI0 - Responsible Innovation in a Global Context- Make it matter!**

**Description:** The motto of quartile 2 is: make it matter. This means that the emphasis in this quartile is even more on the actual design of your responsible innovation idea. After understanding why and how the specific context of your project matters (Q1) and what design options there are for your innovation, you will now "make your project matter".
Supervised by TU/e staff and the company/non-for-profit supervisor(s) your student team will further design the innovation, taking into consideration the diverse contextual aspects identified in Q1.

**Provided by:** Bachelor College, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 2– Timeslot A

**Responsible Lecturer:** dr. J.I. Höffken

**0SAUG0 - Responsible Innovation in a Global Context – External matters!**

**Description:** Quartile 3 is termed “External Matters”. After understanding your project (more) in depth (Q1), and after having concentrated on actually making your project in Q2, Q3 will be about “opening up” again. Q3 will introduce to you “the world” outside, even beyond your project. You will get in touch with diverse stakeholders working in the field of Responsible Innovation in a global context. This will feed into your final efforts to make sure that the innovation you have been working on during the last 3 quartiles will actually “land” and have an impact for the world.

**Provided by:** Bachelor College, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 3– Timeslot A

**Responsible Lecturer:** dr. J.I. Höffken
Technology has hurled humanity into today’s high tech civilization. Yet all is not well aboard Spaceship Earth. How can we design technology that gives stagnant economies new impulses, bolster democracy, heal the planet, makes our civilization sustainable? In this USE line, you build the skills to translate ‘sustainability’ into measurable goals, to identify the right challenges and design strategies for developing technological solutions that work.

**7XEUA0 - Design for a Sustainable Future: exploratory**

**Description:** We introduce the concept of sustainability within an evolutionary framework; present tools for sustainability analysis in its social, economic and ecological dimensions; and discuss methods for framing and addressing complex (wicked) problems. The course encourages critical scrutiny of technologies for their true effectiveness and risks. We build upon this in the Specializing courses, where you will be invited to apply this thinking in specific contexts (urban societies, user empowerment, business models).

**Provided by:** Bachelor College, the Built Environment

**Credits (ECTS):** 5

**Planning:** Quartile 1– Timeslot A

**Responsible Lecturer:** drs. J.G.A. van Zoest

**7XSUA0 - Design for a Sustainable Future: specializing / USER**

**Description:** The main questions addressed by the course are:
- How the concept of sustainability changes when the playing field changes
- Moving centre stage: why users matter.
- How we learn: How should we place man in relation to his environment so as to be able to speak usefully about their relationship from a design/user point of view?
- How we use: How should we describe the user and his impact upon the environment?
- What about non-users as agents of technological change?
- Use and the issues of gender, power and diversity.
- Progress, what progress? How do various models of progress relate to the idea of a sustainable future?
- Thinking globally: How should we think about the relationship between the global and the local?
- Participatory design approaches in the global North and South
- Thinking about doing: how should we approach sustainable design?

**Provided by:** Bachelor College, the Built Environment

**Credits (ECTS):** 5

**Planning:** Quartile 3– Timeslot A

**Responsible Lecturer:** dr. O. Druta
7XSUB0 - Design for a Sustainable Future: specializing / SOCIETY

Description: The course consists of two sections. The first section introduces science of cities, city diagnosis and problem framing, and adaptive city strategies. The second section introduces change management tools, including visions, foresights and scenarios; and systemic approaches to radical change and governance.

Provided by: Bachelor College, the Built Environment

Credits (ECTS): 5

Planning: Quartile 3– Timeslot A

Responsible Lecturer: dr. O. Druta

7XSUC0 - Design for a Sustainable Future: specializing / ENTERPRISE

Description: The “real” green market is very limited. Although sustainable and green concepts are very beneficial for the longevity and health of society and individuals, these concepts typically have a substantially higher price tag. Thus, technology innovation has to be supplemented with business model innovation, taking into account the current and expected governmental regulations and other contextual factors. This course will therefore immerse you into the world of business model innovation in order to make a green firm a commercial success. Moreover, you will learn how multiple actors and business models depend on each other and together form an ecosystem creating and delivering value to their customers.

Provided by: Bachelor College, the Built Environment

Credits (ECTS): 5

Planning: Quartile 3– Timeslot A

Responsible Lecturer: dr.ir. J.C.C.M. Huijben

7XAUA0 - Design for a Sustainable Future: project

Description: The following is an example of a project: A number of student-groups will assess 10 buildings (the exact number may be adjusted) in different cities of the Netherlands. The relationship between the buildings technical properties and their remaining life expectancy will be investigated in terms of ‘Flexibility for conversion’. (Technical building information needs to be obtained from city councils or building investment companies and/or building demolition companies.) Using a preliminary standard assessment method these buildings will be scored by the students on their technical flexibility. Students will investigate whether a relationship between the technical service life and the flexibility properties of the building can be established (survival analysis). Students will then propose possibilities for improvements to existing sustainability measuring systems, by integrating the acquired knowledge and insight from the project.

Provided by: Bachelor College, the Built Environment

Credits (ECTS): 5

Planning: Quartile 1/2/3/4– Timeslot A

Responsible Lecturer: dr. O. Druta
10. TU/e Master of Science certificate: ‘Technology for Sustainable Development’ (TSD/MSc)

Aims and target group

The TSD/MSc certificate is meant for all MSc students at the TU/e.

It is relevant for students who want to contribute to social and environmental sustainability, whether at home or abroad. Negative impacts from conventional economic modernization strategies are becoming ever more obvious and require urgent action, by people working in government, the private sector, and NGOs.

There is a growing demand for scientists and engineers who have an awareness of how sustainability problems play out in different socio-economic and cultural environments, and who have the skills to address these problems in diverse settings and perform well in multidisciplinary project teams. This MSc certificate equips students for a career in this domain, with a global perspective. It trains them to be able to act both in developed and developing countries across the world.

With this certificate the TU/e declares that the owners are also experts of sustainable development within their field of expertise.

Competencies / learning outcomes

The TSD/MSc certificate shows that you:

- are familiar with, and can reflect on the key environmental and social challenges that are occurring in a variety of socio-economic and cultural contexts, and understand their major causes and impacts
- can identify important environmental and social exclusion problems and major research areas within your own field of expertise concerning sustainable technology;
- are aware of common limitations of science & engineering-driven “solutions” for sustainability problems, and know how to avoid such dead ends;
- have mastered sound management approaches for working towards the solution of these challenges in a socially and environmentally responsible manner, such as participative stakeholder governance and responsible innovation;
- are capable of integrating aspects of environment and social inclusiveness in innovation design processes in your own field of expertise;
- recognize the multidisciplinary character of sustainable technology;
- are capable of working in multidisciplinary teams.

Content

The certificate consists of 20 ECTS worth of courses. Students have to complete at least 10 ECTS on top of their regular course program.

One of the components should take the form of a project, which will count for 5 ECTS. The type of project that can be undertaken is flexible, as long as the orientation is clearly on social and/or environmental sustainability. Suitable projects can be an MSc internship or an MSc thesis project. In due course a dedicated TSD project course may also be offered.

At least two core courses have to be chosen out of the following three (all are 5 ECTS):
- 0EM150 Sustainability Transitions and Responsible Innovation
- 0EM200 - International Sustainable Development
- 0EM310 - From Industrial Ecology to Cradle to Cradle

1 Subject to approval in advance by the certificate coordinator.
Other suitable courses (all 5 ECTs) are:
- 0EM140 - Energy, economy and society
- 0LM130 - Ethics and the Risk Society
- 0HM260 - Environmental Psychology
- 1CM170 - Sustainable Supply Chains
- 12M150 - Innovation space project
- 4EM70 - Sustainable Energy Sources
- 7QW3M0 - Urban Planet

And any other MSc course with a clear focus on sustainability. For Inspiration, have a look at the courses promoted in this study guide. This course is subject to approval in advance by the certificate coordinator. For further information please look at the education guide.

Contact
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Course planning 2019-2020

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11. Certificate courses ‘Technology for Sustainable Development’ (TSD/MSc.)

**OEM140 - Energy, economy and society**

**Description:** A reliable, affordable and clean energy supply is of major importance for society, economy and the environment – and will prove to be crucial in the 21st century. You, as future engineer, will be shaping the renewable energy revolution. But before you can do that, you will first have to know and understand the role of energy in economy and society - and that is what this course is about. We will start by highlighting the importance of energy, the big issues that we are facing and the need for an energy transition. We will draw upon energy transitions from the past (from traditional biomass to coal, and from coal to oil) to understand how such a process evolves.

**Provided by:** Graduate School, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 2 – Timeslot E

**Responsible Lecturer:** dr. H.A. Romijn

**OEM150 - Sustainability Transitions and Responsible Innovation**

**Description:** Persistent problems confronting contemporary modern societies such as climate change or loss of biodiversity require a transformation of the way human needs for mobility, energy or shelter are provided. Radical innovations are increasingly expected to provide novel solutions. As much as solving technological problems by means of e.g. improving the efficiency of solar cells or the technical safety of an electronic patient file is an important aspect, at the same time it is not a sufficient condition for a successful change of these systems. Ethical and social consequences of technological developments need to be considered to prevent technologies from failing. Moreover, the implementation of such promising socio-technical innovations like sustainable energy or healthcare projects is not a simple straightforward process. Innovation studies have pointed at the importance of experimentation, collaboration and learning in the development of such radical innovations.

**Provided by:** Graduate School, Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 3– Timeslot C

**Responsible Lecturer:** dr.ir. A.J. Wieczorek
**0EM200 - International Development and Sustainability**

**Description:**
We start with an exploration of the different approaches to thinking and action in international development in the South from 1950 to the present day. The largely non-indigenous nature of technological development gives rise to many problems in countries in the South. "Sustainability" points to the requirement of inclusive development, i.e. the requirement that the costs of comprehensive social-economic transformations are not devolved to marginalized people or future generations; yet, new technological innovations that are introduced also need to be economically viable in the local context.

**Provided by:**
Graduate School, Industrial Engineering & Innovation Sciences

**Credits (ECTS):**
5

**Planning:**
Quartile 3 – Timeslot E

**Responsible Lecturer:**
dr. J.I. Höffken

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**0EM310 - From industrial ecology to sustainability assessment**

**Description:**
Mass and energy flows are crucial for our daily lives, economies, and production, but come with serious concerns: depletion, global warming, and other environmental impacts. Industrial ecology provides a conceptual framework for studying this type of man-nature interactions and as such provides a basis for broader sustainability assessments. These sustainability assessments focus on broader people-planet-profit dimensions and long-term consequences. The course consists of two parts. In the first part, the field of Industrial Ecology and Sustainability Assessment will be introduced.

**Provided by:**
Graduate School, Industrial Engineering & Innovation Sciences

**Credits (ECTS):**
5

**Planning:**
Quartile 4 – Timeslot D

**Responsible Lecturer:**
dr.ir. A.F. Kirkels

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**0HM260 - Environmental Psychology**

**Description:**
Environmental psychologists study the role of the environment in explaining human behavior and experience; investigating, for example, the effects of environmental characteristics (e.g., temperature) on our behavior and well-being or our use of space and environmental information to achieve behavioral or cognitive goals. Offering a concise but in-depth excursion into this sub-discipline of psychology, this course aims to assist you in acquiring solid expertise in knowledge and skills regarding the presuppositions behind, and the application of theories about human-environment interrelationships.

**Provided by:**
Graduate School, Industrial Engineering & Innovation Sciences

**Credits (ECTS):**
5

**Planning:**
Quartile 3 – Timeslot E

**Responsible Lecturer:**
dr.ir. A. Haans
0LM130 - Ethics and the risk society

Description: We live in a world where we increasingly control and know about the risks imposed on ourselves and others, in technological development, global health, the economy and the environment. Yet the increasing interconnectedness of our actions, for example through globalization, and dependence on a technological and information commons, make it difficult for any one agent to control the net risks to which individuals and particular groups are exposed. Students will develop an analysis of risk through the examination of cases such as environmental risks and sustainability, the nuclear power industry, and terrorist threats linked to new technologies.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot D

Responsible Lecturer: dr. G.J.T. Bombaerts

1CM170 - Sustainable supply chains

Description: We cover topics such as energy and climate, life cycle assessment, scarcity of resources, business implications of sustainability, closed-loop supply chains, carbon allocation and footprinting, carbon emissions and logistics, sustainable supply chain design, green sourcing, supply chain collaboration for sustainability, design for sustainability, and social responsibility in supply chains.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot E

Responsible Lecturer: dr. T. Tan

1ZM150 - Innovation Space project

Description: This course aims toward challenge-based, project-based learning in interdisciplinary student teams, working on open-ended assignments in close interaction with high-tech companies and societal organizations. The course involves no lectures, but studio style group work, self-study and personal and team development. The project will include defining and refining (i.e. co-evolution of) a problem and ideas for a solution simultaneously and iteratively through analysis, synthesis and reflection processes.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 10

Planning: Quartile 3 – Timeslot B, E

Responsible Lecturer: prof.dr.ir. I.M.M.J. Reymen
4EM70 - Sustainable energy sources

Description: PART A: General concepts, principles and methods:
The course concentrates on the following common sustainable energy sources, their conversion and storage: Solar energy; Energy from biomass; Geothermal energy; Wind energy.
PART B: Design of a geothermal combined heat & power (CHP) plant:

Provided by: Graduate School, Mechanical Engineering
Credits (ECTS): 5
Planning: Quartile 2 – Timeslot A
Responsible Lecturer: dr.ir. M.F.M. Speetjens

7QW3M0 – Urban Planet

Description: This class provides a high-intensity introduction to the history and theory of global urbanisation. Drawing from an interdisciplinary literature ranging from planning and urban theory, and history, and the urban social sciences, the course explores the emergence, development and continual transformation of cities in relation to changing configurations of urbanization and myriad socio-spatial struggles.
The course aims to juxtaposes conceptualizations of North Atlantic metropolitan life with those emerging today in the Global South through social history and urban geography.

Provided by: Graduate School, the Built Environment
Credits (ECTS): 5
Planning: Quartile 4 – Timeslot D
Responsible Lecturer: ing. J.P.F.A. Snijders
12. Other Master courses relevant to Technology for Global Development

0EM110 - Research Methodology for the Innovation Sciences

Description: The course addresses three kinds of choices that IS researchers make, implicitly or explicitly, when creating IS knowledge. These are choices about (1) the type of knowledge they want to produce, (2) the research design needed to produce that knowledge, and (3) concrete research tools for data collection, analysis, interpretation, and validation.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 1 – Timeslot B

Responsible Lecturer: prof. dr. F. Alkemade

0EM170 - Global Connections

Description: This course illustrates how seemingly local transformations and innovations have a global dimension that often remains hidden. To fully understand localised technological developments, it is essential to understand how they are intertwined with global developments and their social contexts. Global connections are key in this process. We will focus on global connections of two different kinds: material based connections like information, communication, and transport technologies and the institutional and human relations in knowledge systems. Concepts of globalization, globalization and appropriation will be introduced and discussed.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 2 – Timeslot C

Responsible Lecturer: dr. M. Davids

0LM150 - Entrepreneurship and Corporate Social Responsibility

Description: The course is divided into two parts. In the first part we clarify the hazard to which business ethics is a response and to identify the idea of conscience in relation to corporate culture. We will examine the role of moral reflection (conscience) in the lives of each of us as individuals and the corresponding role it plays in the culture of an organization. The second part focuses on the application of the conceptual foundations laid in the first part.

Provided by: Graduate School, Industrial Engineering & Innovation Sciences

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot B

Responsible Lecturer: dr. S.R. Nyholm
3MP110 - Solar cells

Description: Properties of light, properties of (inorganic and polymer) semiconductors, properties of a p-n junction. Principles of photovoltaic energy conversion discussed with the case study of crystalline silicon solar cell. Mathematical model deriving the current-voltage characteristics for a diode in dark and under illumination conditions. Detailed overview of the physical/working principles and production technologies for the different types of solar cells. Assessment of the several solar cell generations in terms of cost reduction and improvement of efficiency.

Provided by: Graduate School, Applied Physics

Credits (ECTS): 5

Planning: Quartile 3 – Timeslot D

Responsible Lecturer: prof.dr. M. Creatore

4AT020 - Clean Engines and Future Fuels

Description: First, all relevant processes in an internal combustion engine will be characterized, with particular focus on physical and chemical fuel properties. Ultimately, the student should follow the 'reverse engineering' approach: 'design' a new fuel given certain demands. Next, new combustion concepts will be introduced, which are predominantly homogeneous in itself. (Dis)advantages are listed and operational limits are discussed. Furthermore, an outlook will be given regarding next generation aftertreatment systems and possible combination with advanced combustion concepts.

Provided by: Graduate School, Mechanical Engineering

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot C

Responsible Lecturer: dr.ir. X.L.J. Seykens

4GA50 - Solar heat system

Description: In this design study, the students design and realize a small scale Solar Heat Storage System. For the optimization of this system need a (quasi-) 1D model of a solar collector and associated storage vessel needs to be developed, which should deal with various different heat transfer mechanisms:
- Conductivity: for the determination of an ideal insulation material and thickness
- Convection: internal convection tube and natural convection
- Radiation absorption of radiant heat in the absorber
- Heat capacity / heating

Provided by: Graduate School, Mechanical Engineering

Credits (ECTS): 5

Planning: Quartile 4 – Timeslot D, E

Responsible Lecturer: dr.ir. A.J.H. Frijns
5LEB0 - Environment and power engineering

Description: 5LEB0 comprises the composition of an essay regarding environment aspects of power engineering and solutions. Topics comprise emerging technologies. The essay should imply a grand, state of the art overview of the subject area obtained from scientific literature (publications & books). Apart from data acquisition, the key issue of 5LEB0 is data interaction, adding a personal signature.

Provided by: Graduate School, Electrical Engineering
Credits (ECTS): 2.5
Planning: Quartile 1
Responsible Lecturer: dr.ir. W.F.L.M. Hoeben

7LS3M0 - Sustainable buildings/ physical aspects of building materials

Description: The sustainable building module addresses the integral sustainability of buildings, construction materials and products. This is done by considering the raw materials, way of production, as well as the properties of building materials, building products and the entire construction chain. Besides this material aspect, attention is also paid to sustainable land use, water and energy systems. The student will be able to assess buildings in regard to their sustainability, make basic designs of sustainable buildings based on the functional requirements, taking account of the four themes energy, materials, water and space.

Provided by: Graduate School, the Built Environment
Credits (ECTS): 5
Planning: Quartile 1 – Timeslot A
Responsible Lecturer: prof.dr.ir. H.J.H. Brouwers

DCM130 – Design for Social Innovation

Description: - To get acquainted with the transformation economy (including related theories) that focus on addressing larger societal challenges, learn how this new paradigm boosts social innovation and transformative practices.
- To get acquainted with 1st, 2nd and 3rd person perspectives, embodied theories, micro-meso-macro lensen, aesthetics of transformation and situated practices.
- To be able to communicate about your findings through various media, including a public exhibition, a video and infographics, to stimulate debate with people from various backgrounds.

Provided by: Graduate School, Industrial Design
Credits (ECTS): 5
Planning: Quartile 2 – Timeslot E
Responsible Lecturer: prof.dr.ir. C.C.M. Hummels
13. **PhD & PDENG Courses relevant to Technology for Global Development**

**OPDE05 - Innovation Camp: Bootcamp for transformative approaches to energy, mobility and smart cities**

**Description:**
Cities around the world face numerous challenges. In particular, urban energy and mobility systems are under pressure due to the increasing resource depletion and climate change. Their transformation requires not only innovative technologies, but also a radical change of the entire system in which these technologies are embedded including regulations, culture, practices and routines. However, a key question is how to transform the current unsustainable energy and mobility practices in the city of today and create smart cities of tomorrow?

**Provided by:** Industrial Engineering & Innovation Sciences

**Credits (ECTS):** 5

**Planning:** Quartile 2

**Responsible Lecturer:** dr.ir. A.J. Wieczorek