TM5

Technology Assessment

An approach for organizing societal discourse on innovative energy technologies

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Funded by the Erasmus+ Programme of the European Union

Introduction

The long-term consequences of technical developments are often hard to predict. In an attempt to address this problem, an interdisciplinary approach for assessing technologies was developed during the 20th century. Technology assessments involve the analysis of possible scenarios regarding the opportunities and risks of technical developments, as well as the provision of advice for technology policymakers and society more generally (Grunwald 2010).

All areas of our life are intertwined with and permeated by technologies. They are ubiquitous and shape our lives at home and at work. They affect our health, the ways we interact with others, and our relationship with nature (Bijker, Law 1992). For centuries, technological development has facilitated and benefited our lives and increased our well-being. However, technologies have also caused serious environmental problems and negatively impacted societies and our social lives. Since the 1970s, concerns about the negative consequences of technological development have increasingly triggered public debates and large technology projects have been met with public resistance (Van Eijndhoven 1997). Such debates revealed that different groups of actors held diverging views about the potential effects of technologies.

The development of technology assessment (TA) methods was driven by multiple factors: concern about the consequences of new technologies, a desire to provide 'objective' information about such impacts at an early stage and ideally avoid unfavorable side effects, as well as the need for ex-ante assessments of technological government projects.

> » *TA was conceived as an analytic activity, aimed at providing decision makers with an objective analysis of the effects of a technology" (Van Eijndhoven, 1997). Technology assessment makes use of various methods and conceptual approaches and aims to integrate technological, environmental, economic, as well as social and ethical aspects into the assessment of technologies (Grunwald 2010).*

These days science, technology and innovation are still seen as preconditions for people's well-being and the economic development of our societies. It is considered necessary and important to guide technological development based on democratically legitimate policies. Over the past decade, and particularly in European countries, approaches to TA have been developed and applied that seek to improve the assessment process itself and actively integrate a societal perspective (e.g. real-time TA, consensus conferences, participatory TA) (e.g. Van Eijndhoven 1997). However, working out how to best integrate societal perspectives into TA remains a challenge.

In this module students will learn about the historical development of technology assessments, the current role of parliamentary technology assessments in Western societies, as well as the basic principles of technology assessment. Students will acquire knowledge about the current practices involved in technology assessment, its basic assumptions and main goals. The last session focuses on the methods used to fulfill the diverse functions and aims of technology assessment. Particular emphasis is placed on system analysis approaches that are designed to identify the economic, social and environmental impact of emerging technologies.

The module sessions link theoretical and methodological aspects with practical examples from energy research and energy technology development.

Teaching Module structure

The module is most suitable for a group of 10 to 25 students and consists of three sessions of one and a half hours each. The lessons can be taught in the course of one day or on three separate days. If the module is taught in one day, there should be breaks between the sessions.

The teaching module is composed of 3 successive sessions:

1

Session 1: History and functions of technology assessment
provides a general introduction to the issue of technology assessment and an overview about the historical development of (parliamentary) TA.

90 minutes

2

Session 2: Dimensions of technology assessment
focuses on TA's function as a way of providing knowledge to policymakers/politicians and society about the potential impact of technologies.

90 minutes

3

Session 3: Actors and methods of technology assessment
provides an insight into the methods and techniques of TA. The roles of different actors are discussed and a variety of TA approaches are introduced. The social life cycle assessment (sLCA) method is presented in detail in order to exemplify system analysis approaches.

90 minutes

Session 1:

History and functions of technology assessment

a) Session objectives

This session features a general introduction to the topic of technology assessment. It provides an overview of the historical development of (parliamentary) TA, and TA's functions in Western countries. It also introduces the principles, goals, and functions of technology assessment and related political decision-making.

b) Session scope

Technology and society

All areas of our life are intertwined with and permeated by technologies. They are ubiquitous and shape our lives at home and at work. They affect our health, the ways we interact with others and our relationship with nature (Bijker, Law 1992). Technology, society and the environment are interdependent; technologies are shaped by society, social processes, structures, and relations (Bijker & Law, 1992). For centuries, technological development has facilitated and benefited our lives and increased our well-being. However, technologies have also caused serious environmental problems, impacted societies in unforeseen ways, and caused controversies.

Assessing the effects of technology

IIn Western Europe and other countries that pioneered industrialization, energy technologies such as steam engines became an issue of societal concern. There were increasing calls for the state to influence and regulate the development of these technologies. The contradictory aspects of technologies for the welfare and prosperity of society became part of the discussion. Debates about technologies addressed their manifold impacts on society: on the one hand, technologies were facilitating work, while on the other, technologies were causing occupational accidents and the loss of traditions. This led to state interventions and regulations.

In the 1950s and 1960s technical developments and related social, ecological and ethical challenges and conflicts led to increasing social awareness about the impact and consequences of technologies. This led to political demand, which in turn prompted the development and eventual institutionalization of technology assessment (TA) in parliamentary organizations (Van Eijndhoven 1997; Woopen, Mertz 2014). TA was designed to inform and advise policymakers/politicians and society regarding unforeseeable and unfavorable consequences of technological development (Van Eijndhoven 1997; Woopen, Mertz 2014).

» *PARLIAMENTARY TECHNOLOGY ASSESSMENT AS IT IS UNDERSTOOD TODAY IS A POLITICAL INSTRUMENT THAT SUPPORTS THE DESIGN AND REGULATION OF TECHNOLOGY.*

Functions of Technology Assessment

» *The overall goal of TA is to contribute to the formation of public and political opinion and to inform political decision-making.*

But the outcomes of TA do not automatically lead to decisions—they only inform political decision makers. TA generates knowledge that can be used to help solve societal and political problems related to technology, but it is neither able nor legitimated to solve those problems by itself. TA has several functions: reflection about technological impacts (this is what the students will do in the group work of this session.), political and societal consultation (this function will be addressed in the group work of the second session of this module.), identification and management of conflicts (see TM 7 for details on technological conflicts), democratization of technology, Societal governance of technology.

In the first few decades, assessing technological impacts and providing information and knowledge for decision-making (institutions) were TA's key objectives, however the focus has recently shifted more and more towards integrating broader societal perspectives (the perspectives of diverse societal actors and groups) into assessment processes. Furthermore, societal consultation is increasingly considered to be important. Although the impacts of technology and the identification of unintended and unfavorable developments are still the primary functions of technology assessments, the focus is increasingly shifting towards the need to influence technology development in its early stages (Guston 2014; Ely et al. 2011).

c) Pre-reading

No.	Author and title	Description
1.	Coates, Joseph. Historical Lessons from Technological Disruptions: Will the Storm Always Pass? "Technological Forecasting and Social Change" 1997, Vol. 54, Issue 1. DOI: 10.1016/S0040-1625(97)87501-4	This article begins by discussing the impact that technological innovation has on society. The author provides a good historical overview of the practice of technology assessment. The article is easy to understand for non-SSH experts.
2.	Van Eijndhoven, Josée. Technology Assessment: Product or Process? "Technological Forecasting and Social Change" 1997, Vol. 54, Issue 2-3. DOI: 10.1016/S0040-1625(96)00210-7	In this article, Van Eijndhoven starts with a definition of what TA meant originally: "TA was conceived as an analytic activity, aimed at providing decision makers with an objective analysis of effects of a technology" (Van Eijndhoven, 1997). In the introduction, she reflects on differences in the institutionalization of TA in different European parliaments. Van Eijndhoven then discusses the challenges of involving multiple perspectives into technology assessment processes. She describes four central paradigms of technology assessment and how they impact the performance of TA processes: the classical paradigm, the paradigm of the Office of Technology Assessment (OTA), public TA, and constructive TA. The article concludes by showing lessons that can be drawn from this analysis, as well as the dilemmas facing technology assessment.

d) Session activities

Activity 1: Introductory lecture

Methods	Lecture
Keynotes	None
Materials	**TM5-S1-RM-01_ppt_introduction TA**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Students gain a first impression of the module content. They conduct a short group work exercise that introduces them to the basic principles of technology assessment.

In this session the teacher introduces the overall goal and the agenda of the module and briefly explains the content of the three lessons, as well as of this session. **The teacher choses one of the two examples** described in activity 2, then introduces the following group work.

Activity 2:
Group work

Methods	Group work
Keynotes	The students shall NOT read the Energy Roadmap! Students shall develop decision-making criteria from a specific actor's perspective. They shall critically reflect upon and discuss these criteria.
Materials	**TM5-S1-RM-02_EU_Energyroadmap_2050 – as background information for the teacher only** **TM5-S1-RM-03_Introduction EU roadmap_teacher** **TM5-S1-RM-04_Handout_EU roadmap** **TM5-S1-RM-05_Introduction new heating system_teacher** **TM5-S1-RM-06_Handout_New heating system** **TM5-S1-RM-07_Handout_New heating system_teacher**
Required accessories	Flipchart paper for each group (1-2 sheets) and flip chart markers
Time allocation	20 min
Learning outcomes	The students will learn that a clear question is needed as a basis for deriving decision-making criteria for technological choices. They will reflect on the limits of the specific actor's knowledge and develop a strategy regarding how and from whom that actor can gain the relevant knowledge. The students will become familiarized with the basic principles of technology assessment.

Regardless of which example or option is chosen, the students form groups of 3-4 people (group size may be adjusted to suit the total number of participating students; however, a total number of four groups should not be exceeded). The students are asked to take notes during the group work, so that they can document the main points of the discussion. One student from each group presents the results during the next activity.

Example 1: EU Energy Roadmap 2050

Introductory material teacher: TM5-S1-RM-03_Introduction EU roadmap_teacher
Group work teaching material: TM5-S1-RM-04_Handout_EU roadmap

The teacher introduces the EU Energy Roadmap 2050, using the material **TM5-S1-RM-03_ Introduction EU roadmap_teacher**. The entire roadmap text can be used by the teacher as background material. Students should not read it during the session, there is no time foreseen for. (**TM5-S1-RM-02_EU_Energyroadmap_2050**):

- **Option 1:** *Students shall build three groups. One group take the perspective of a politician, another of a CEO of a major energy company, another the perspective of a scientist. The groups discuss the questions indicated in TM5-S1-RM-03_Handout_EU roadmap.*
- **Option 2:** *Each group of students can discuss the questions indicated in TM5-S1-RM-03_Handout_EU roadmap taking the same perspective. In that case we suggest to take the perspective of a politician.*

Example 2: Heating your home

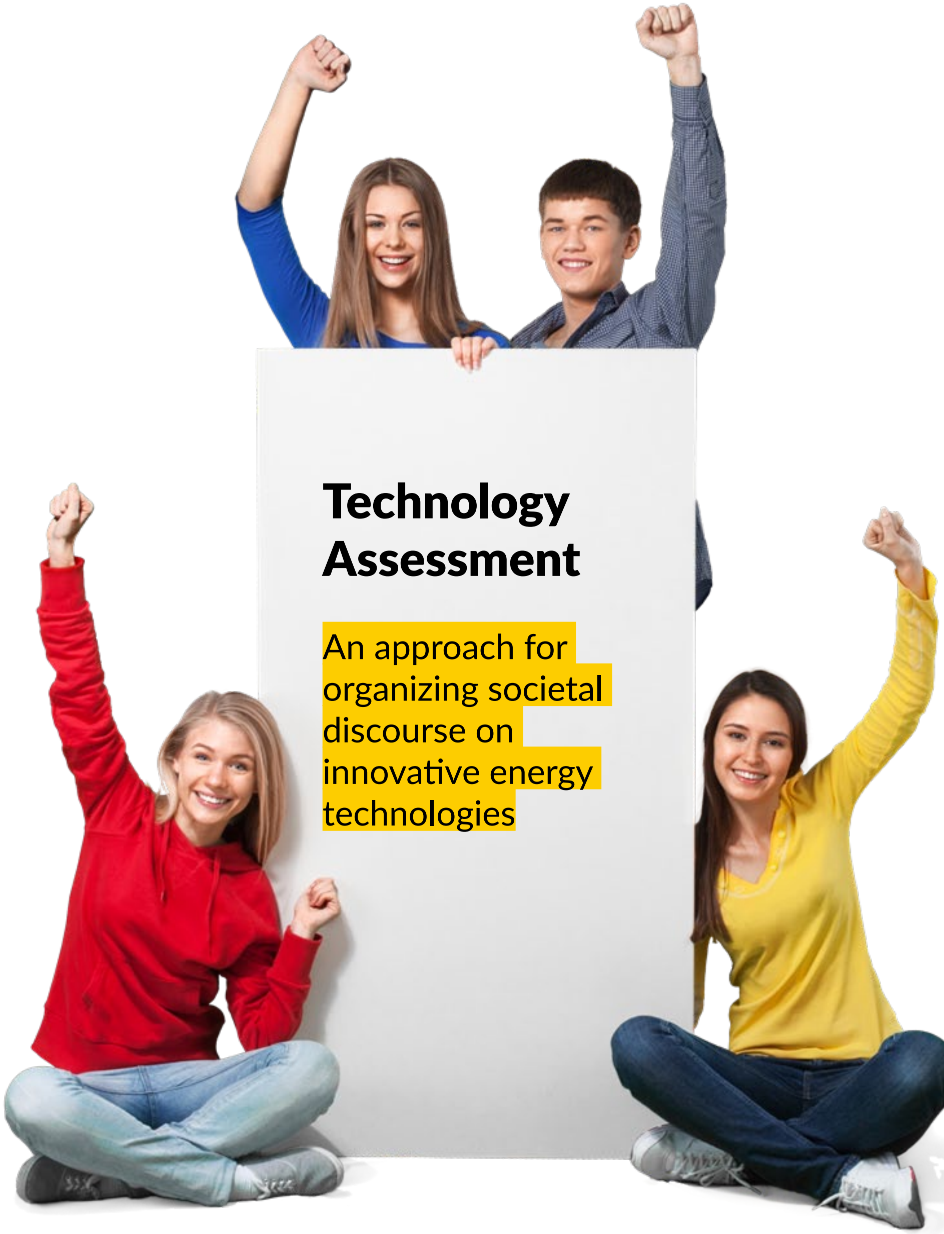
Introductory material teacher: TM5-S1-RM-05_Introduction new heating system_teacher
Group work teaching material: TM5-S1-RM-06_Handout_New heating system

The teacher illustrates the problem of heating homes using the material **TM5-S1-RM-05_ Introduction new heating system_teacher.**
Question for the students:

- **Group 1:** *Imagine, you are a homeowner and it is necessary to change the heating system in the house. Which system do you choose? How do you reach this decision?*
- **Group 2:** *Imagine you are director of a company that sells and installs heating (and cooling) systems. Your company is asked to replace the heating/cooling system in a house. Which new system do you recommend to the homeowner? Why do you recommend that system in particular?*

Activity 3: Discussion

Methods	Presentation, discussion
Keynotes	The teacher should guide the discussion towards central aspects that have to be taken into account in TA and summarize them at the end (see below). Summarize and conclude the discussion.
Materials	**None**
Required accessories	None
Time allocation	35 min
Learning outcomes	The students will reflect on the group work and practice how to condense and present the results of their discussions to a broader audience. They will learn that the answers to the questions and the evaluation of the technologies will differ, depending on the perspective taken – politician vs. scientist vs. NGO; homeowner vs. installation company. The students will experience how values and interests come into play when technologies are being assessed. They will learn that it is important to clarify who performed the assessment. This activity also teaches students the central aspects of technology assessment.



After the group work, the students come together and briefly present the main points of the discussions they had in the working groups. The following joint discussion is guided by the teacher to ensure it covers the following (central) aspects that have to be taken into account when assessing technologies:

1. **A clear question** is needed to guide the process of technology assessment. Further questions have to be specified during the TA process.

2. Technologies and **measures are evaluated** and compared with each other.

3. **Evaluation criteria** have to be defined (in the EU roadmap example criteria are provided; in the heating system example criteria have to be defined by the students). Potential risks are an important criteria in technology assessment.

4. Technology is evaluated in relation to time. **Future scenarios or clear future objectives are imagined and the role of the technology within this future is evaluated.**

5. Often **external knowledge and expertise** have to be taken into account within the evaluation process. Decisions have to be made about who can provide external expertise and knowledge (which actors or organizations).

6. The **result of the evaluation depends on who evaluated** the technological options (scientists, politicians, NGOs, businesses, private individuals, etc.). Values and interests come into play during technology assessments. The person/group/organization who conducted the evaluation should always be clearly indicated.

Activity 4: Lecture

Methods	Lecture
Keynotes	None
Materials	**TM5-S1-RM-08_ppt_history TA** **TM5-S1-RM-09_national energy plan 1977 – as background information for the teacher only** **TM5-S1-RM-10_report Chernobyl nuclear power plant – as background information for the teacher only**
Required accessories	Projector, laptop
Time allocation	25 min
Learning outcomes	Students will learn how technological changes and the social implications of using technologies have been viewed and understood by (Western) societies over the past centuries. They will become familiar with a historical perspective on technology assessment.

Technology and society

All areas of our life are intertwined with and permeated by technologies. They are ubiquitous and shape our lives at home and at work. They affect our health, the ways we interact with others and our relationship with nature (Bijker, Law 1992). Technology, society and the environment are interdependent; technologies are shaped by society, social processes, structures, and relations (Bijker, Law 1992). For centuries, technological development has facilitated and benefited our lives and increased our well-being. However, technologies have also caused serious environmental problems and impacted societies in unforeseen ways.

In order to minimize the negative effects of using technologies, it appears reasonable to estimate and critically evaluate the consequences of their application.

Critical voices have long accompanied technological innovation and the evaluation of technology has been the subject of controversial political and public discussions. Problems and conflicts related to the development and use of technologies are a part of social life (Scheffczik 2003).

The example of mobility

Cars are a form of technology that became widely used by individuals in the 1960s and replaced other means of transport such as walking, horse-drawn carriages and trains. As a result, the number of deadly traffic accidents increased considerably; the air quality in cities decreased; cities were completely reorganized by the construction of highways, gas stations and other car-related infrastructure; the use of natural resources, especially oil, increased dramatically; remote areas became easily accessible. Cars dramatically changed societies, our daily practices, and our relationship with nature.

Assessing the effects of technology – A historical perspective

The debates about the negative impacts and legitimization of mining activities in the pre-industrial period (mid-16th century) provide an early example of technological controversies and assessments. The well-known researcher, physician and public servant Georgius Agricola argued that the social benefits of metals were more important than the damage caused by mining exploration. He came to this conclusion by weighing up the advantages of mining technology against its negative impact on the environment and human health. In other words, he assessed the technology.

In Western Europe and other countries that pioneered industrialization, energy technologies such as steam engines became an issue of societal concern. In the first half of the 19th century, the consequences of steam boiler explosions were an important and widely discussed issue. Events and developments that caused a high number of accidents and deaths were perceived as especially dangerous. There were increasing calls for the state to influence and regulate the development of these technologies. Interestingly, human health risks caused by gas and dust were considered to be minor concerns at that time (Scheffczik 2003). However, the contradictory aspects of technologies for the welfare and prosperity of society became part of the discussion. Debates about technologies addressed their manifold impacts on society: on the one hand, technologies were facilitating work, while on the other, technologies were causing occupational accidents and the loss of traditions. This led to state interventions and regulations, such as the prohibition of certain machinery or the implementation of legal regulations like the Prussian Steam Boiler Act of 1831 (Scheffczik 2003).

Institutionalization of (parliamentary) technology assessment

In the 1950s and 1960s technical developments and related social, ecological and ethical challenges and conflicts led to increasing social awareness about the impact and consequences of technologies. This led to political demand, which in turn prompted the development and eventual institutionalization of technology assessment (TA) in parliamentary organizations (Van Eijndhoven 1997; Woopen, Mertz 2014). TA was designed to inform and advise policymakers/politicians and society regarding unforeseeable and unfavorable consequences of technological development (Van Eijndhoven 1997; Woopen, Mertz 2014).

Parliamentary technology assessment as it is understood today is a political instrument that supports the design and regulation of technology. It first became institutionalized in the United States. In 1972 the Office of Technology Assessment (OTA) was established as an office of the United States Congress. The OTA aimed to provide a sound analysis of complex scientific and technical issues, which members of congress could use as the foundation for their decision-making. The OTA was closed in 1995. These developments were influential outside the USA and formed the basis for the establishment of TA as a political instrument in many countries (Van Eijndhoven 1997; Ely et al. 2011).

Examples of early assessments of energy technologies and energy-related policies

Analysis of the proposed National Energy Plan in 1977 – Analysis and report by the US Office of Technology Assessment

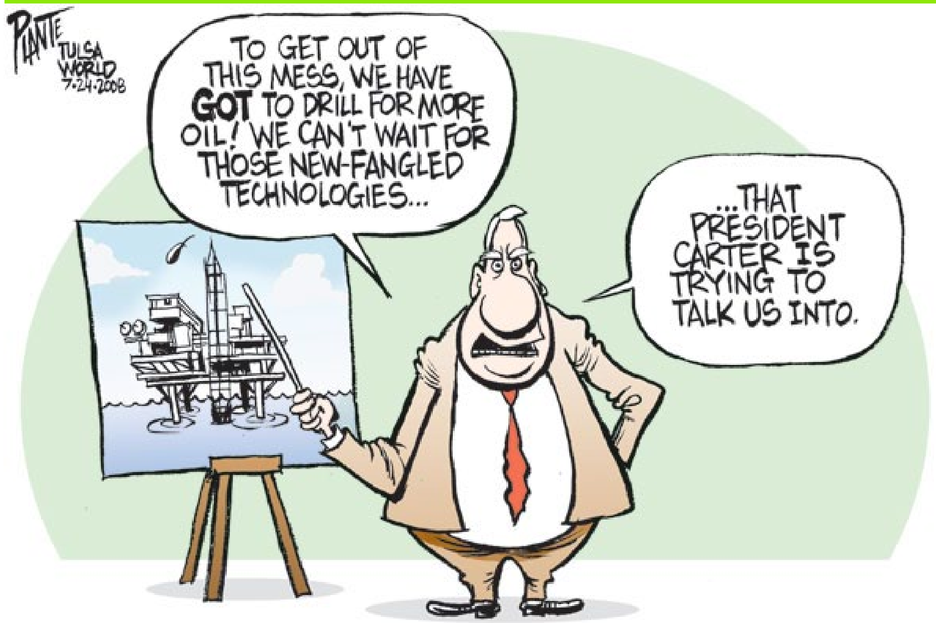


Image source: https://www.rpadden.com/docs/Carterenergyplan.htm

In 1977, the National Energy Plan was presented to the United States Congress. The plan outlined the USA's goals and principles regarding its future provision and use of energy. The United States Office of Technology Assessment (OTA) evaluated the plan. With the help of the OTA study, congress was able to independently assess the energy plan. The study focused on the impact of the National Energy Plan on energy supply, the energy needs of the society, and the impact of energy price changes on fossil fuel supply. (Material: TM5-S1-RM-09_national energy plan 1977).

Consequences of the accident at the Chernobyl nuclear power plant – Report issued by the Parlementaire d´Evaluation des Choix Scientifiques et Technologiques of the French Parliament (OPECST) in 1987

The French parliamentary service for the evaluation of scientific and technological options issued a report asking what lessons France can learn concerning the lack of information during an emergency but also the organization for monitoring the safety and security of nuclear installations. How could, for example, the safety of nuclear power plants be monitored more effectively? This report demonstrated the French parliament's interest in nuclear technology and stated that nuclear power has advantages but must be carefully monitored and controlled by the authorities. (Material: TM5-S1-RM-10_report Chernobyl nuclear power plant).

Technology assessment today – Functions of TA

Today, technology assessment is understood as a scientific, interactive and communicative aspects of science and technology. (One specific form of this is still parliamentary TA.) TA process that aims to contribute to the formation of public and political opinion on societal contributes to the formation of public and political opinion, but the outcomes of TA do not automatically lead to decisions—they only inform political decision makers. TA generates knowledge that can be used to help solve societal and political problems related to technology, but it is neither able nor legitimated to solve those problems by itself.

Grunwald (2010) described the following functions of TA :

- *Reflection about technological impacts:* (This is what the students do in the group work of this session.) Unfavorable and undesirable consequences of technology occur as a result of scientific and technical progress. Technology assessment is an instrument used to investigate potential future developments caused by technologies. Societal and political actors expect TA to reveal both the foreseeable and the unknown effects that new technologies may have on society and the environment (particularly any undesired impact and risks). The potential and risks of new technologies and technological trends should be evaluated in their early stages of development. TA is designed to provide knowledge and orientation for decision-making in relation to technology policy.

- ***Political and societal consultation:*** (This function will be addressed in the group work of the second session.) Modern societies increasingly depend on technologies and technological innovation. As new technologies often cause unforeseeable developments, the need for consultation and guidance among decision makers has increased over the past few decades. Technology assessment was originally developed to provide policy advice. It is an instrument that aims to predict future developments related to technologies and generate research results for the purposes of decision-making and the formation of political opinion. However, it is also important to take into account societal perspectives and to open technology assessment for democratic processes. Thus, society should have a say in the scientific agenda and the direction of technology development. In this regard, the basic question is: how can members of society direct science and technology development in a direction that benefits society? The role of TA in this context is to lay the foundation for political decision-making. TA also typically involves scientific analysis of the consequences of decisions, of underlying assumptions, and of conditions that make decisions successful, as well as the development of options for decisions regarding political measures and instruments for dealing with technology-related decisions (Grunwald 2010).

- ***Identification and management of conflicts:*** Serious technological conflicts are common in industrialized societies (see TM 5 for details on technological conflicts). Conflicts in science and technology are normal in pluralistic societies. Technological conflicts may arise when groups of actors perceive potential risks differently or hold different positions on existing regulations, e.g. threshold values for pollutants in groundwater. They may also arise from fundamental questions such as the future shape of society, the relationship between humans and the environment, or the future of humanity itself. Detecting technology conflicts early and contributing to their resolution are important functions of technology assessment. Issues such as public communication about technology and risks, mediation, social responsibility, and participation are central to assessments that deal with technology conflicts (Grunwald 2010).

- ***Democratization of technology:*** Technology assessments are a form of scientific consultation for democratic institutions and thereby part of the democratization of technology. Communication between democratic institutions and science is a prerequisite for achieving this goal. However, the democratizing effects of TA performed exclusively by experts and political decision makers have been questioned for decades (in the TA community). Over the past decades, society's expectations regarding TA have shifted towards greater deliberation and increased participation of actors from civil society. Technology assessment should therefore aim to democratize technology and provide advice for societal actors and society. The integration of diverse perspectives into TA processes is also seen as important. Adding these functions to the role of technology assessment influences the shape of TA processes and the methods applied. This trend is reflected by current approaches to TA, such as real-time assessment and participatory technology assessment (Grunwald 2010; Van Eijndhoven 1997; Ely et al. 2011).

- ***Societal governance of technology:*** If we could assume that new technological developments automatically lead to progress, then society could transfer all responsibility for the development of new technologies to industrial actors. However, this is not the case – technology and technological development requires governance. Technology is governed by laws that restrict and regulate research and technology development to enable both: to protect citizens' rights and to create innovations. This is achieved through the development of political frameworks for technological progress. Furthermore, in the 1990s, a cultural understanding of innovation processes emerged that emphasized the idea of the social shaping of technology (Bijker, Law 1994). This perspective focuses on the development and creation of technologies in laboratories and firms . It suggests technology should be understood as something that is created and shaped by social processes and structures – from the initial idea onwards. Consequently, technology assessment should focus on the entire technology development process (not only the implementation of the technology) and also intervene early on in order to promote positive developments and hinder negative developments. This new type of technology assessment that focuses on the design and conditions of technology development instead of the end-of-pipe approach (focusing on the impacts of technology) was introduced in the 1990s (Grunwald 2010).

Summary

The overall goal of TA is to contribute to the formation of public and political opinion and to inform political decision-making. TA has several functions. The relevance of each function varies over time and from country to country (Van Eijndhoven 1997). In the first few decades, assessing technological impacts and providing information and knowledge for decision-making (institutions) were TA's key objectives, however the focus has recently shifted more and more towards integrating broader societal perspectives (the perspectives of diverse societal actors and groups) into assessment processes. Furthermore, societal consultation is increasingly considered to be important. Although the impacts of technology and the identification of unintended and unfavorable developments are still the primary functions of technology assessments, the focus is increasingly shifting towards the need to influence technology development in its early stages (Guston 2014; Ely et al. 2011).

ATTENTION:

Hand out to the students both policy briefs that will be discussed in session 2 (TM5-S2-RM-02_ITA_Energy-efficient Office Buildings, TM5-S2-RM-01_POST_Environmental Impact of Tidal Energy Barrages). Students are required to read them as homework in preparation for the second session.

Session 2:
Dimensions of technology assessment

a) Session objectives

This session focuses on TA as a means of providing knowledge about the potential impacts of technologies for the purpose of informing policymakers/politicians and society more generally. The session aims to introduce the students to the basic structure and dimensions of TA reports.

b) Session scope

Dimensions of technology assessment

» *NEW TECHNOLOGIES MAY IMPACT SOCIETIES IN VARIOUS WAYS.*

Or to put it the other way around: comprehensive technology assessment requires thorough consideration of the impacts that innovative technologies could have in different areas of society. Content of this session are the dimensions of technology assessment. The consideration of the following dimensions will be introduced and discussed within this session: Anthropogenic dimension, Ecological dimension, Social dimension, Socio-cultural dimension, Technical dimension, Scientific/mathematical/logical dimension, Economic dimension, Ethical dimension, Political/legal dimension
TA reports usually focus on some of these aspects (see the documents used in activity 2 of this session).

c) Pre-reading

Both texts shall be handed out to the students at the end of the FIRST session. Students are required to read them as homework in preparation for the second session.

No.	Author and title	Description
1.	Wentworth, Jonathan. 2013. Environmental Impact of Tidal Barrages. The Parliamentary Office of Science and Technology. Code: TM5-S2-RM-01-POST_Environmental Impact of Tidal Energy Barrages	This policy brief summarizes the current knowledge about the environmental impact of tidal energy barrages and describes an appropriate political framework. The brief was written by the United Kingdom's Parliamentary Office of Science and Technology (POST). POST is the Parliament's in-house source of scientific advice about technologies. Its analyses are conducted by a team of specialist advisers affiliated with the office as well as external experts. Input comes from businesses, academia, government, regulators and NGOs. POST is an office of both Houses of Parliament, overseen by a Board of Members of Parliaments, peers and external experts. They aspire to provide independent, balanced and accessible analyses of public policy issues related to science and technology in order to inform parliamentary debate. Further information: https://www.eptanetwork.org/members/full-members/united-kingdom
2.	Ornetzeder, Michael. 2016. Energy-efficient office buildings. Institute of Technology Assessment. Code: TM5-S2-RM-02_ITA_ Energy-efficient Office Buildings	This policy brief was written by researchers at the Institute of Technology Assessment (ITA). It provides a short explanation of the concept of energy-efficient office buildings. The brief focuses on the satisfaction levels of people working in energy-efficient buildings and includes policy advice about whether or not more such buildings should be planned. The ITA is a research facility at the Austrian Academy of Sciences. Its research results provide guidance for decision makers. It is financed by the Austrian Academy of Sciences and by the Federal Ministry for Science Research and Economy, as well as by third parties such as the Austrian Fund for Scientific Research, the European Commission, other federal ministries, and both the Austrian and the European parliaments. The ITA's work is practice-oriented. In their analyses they include practical knowledge from experts, stakeholders and users obtained through participatory methods. Further information: https://www.eptanetwork.org/members/full-members/austria.

d) Session activities

Activity 1: Introduction

Methods	Lecture
Keynotes	Please make sure that the students prepare for the session by reading the two policy briefs as homework. When introducing this session: remind the students about the content of the previous session; highlight some aspects that the students experienced during their group work and some aspects from the lecture (role of technology in society, functions of TA). Remind the students to the institutionalization of TA in European Countries – the following group work deals with a typical document of parliamentary TA.
Materials	**TM5-S2-RM-00_Session scope**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Students gain an initial impression of the session content and understand the task involved in the subsequent group work.

The teacher briefly introduces the content of this session. To do so he or she can use the material TM5-S2-RM-00_Session scope. The teacher explains the starting point of this session: a group task about policy briefs that provide condensed technology assessments related to an energy issue. Policy briefs represent one specific way of communicating information about research findings and technologies to a non-specialized audience, e.g. political decision makers. Scientific and technical knowledge is presented in a very condensed form. Usually comprehensive reports and research projects underlie the very short format of a policy brief. Due to time restrictions comprehensive reports will not be analyzed and discussed in the course.

A policy brief is:

- *A short document that presents the findings and recommendations of a research project or a technology assessment to a non-specialized audience*
- *A medium for exploring an issue and distilling lessons*
- *A vehicle for providing policy advice*

Activity 2:
Group work

Methods	group work (text analysis)
Keynotes	Make clear for the students what type of document a policy brief is (it is not a technical report). The groups can work on the same or different policy briefs. If you have more than two groups, some groups will have to work on the same policy brief. Each group should only discuss one policy brief. The focus of the group work is to analyze content, structure, and aim of the policy briefs. Students shall identify which aspects and potential impacts of the technology are addressed. You can take this up within the presentation of the dimensions of TA (lecture).Students shall discuss the policy briefs from two perspectives: as a researcher who has to bring its research results into this condensed format and as a politician who read this brief.
Materials	**TM5-S2-RM-01_POST_Environmental Impact of Tidal Energy Barrages** **TM5-S2-RM-02_ITA_Energy-efficient Office Buildings** **TM5-S2-RM-03_Handout_POST** **TM5-S2-RM-04_Handout_ITA**

Required accessories	1-2 sheets of flip chart paper for each group and a flip chart marker
Time allocation	35 min
Learning outcomes	Familiarize students with policy briefs a typical format for the communication of research results to non-scientists. Discover the dimensions that a technology assessment can cover. Make students aware for the difficulty of communicating scientific knowledge to non-scientists and non-experts.

The students are asked to form groups of three or four people (group size may be adjusted to suit the total number of participating students, however a total number of four groups should not be exceeded). Each group discusses one of the policy briefs: environmental impact of tidal energy barrages (TM5-S2-RM-01_POST_Environmental Impact of Tidal Energy Barrages OR energy-efficient office buildings (TM5-S2-RM-02_ITA_Energy-efficient Office Buildings). The handouts provide some background information and guiding questions (see Materials). The students are asked to take notes in order to document the main points of the discussion. One student from each group will present the results during the joint discussion.

Activity 3: Discussion

Methods	Presentation, guided discussion
Keynotes	Summarize the discussion and draw a conclusion according to the learning outcomes of the group work.
Materials	**TM5-S2-RM-05_Discussion questions_teacher**
Required accessories	None
Time allocation	30 min
Learning outcomes	Reflection on the group work and discussion of the results.

The discussion is guided by the teacher, who encourages the students to reflect on and discuss the content of the previous group work. To start and stimulate the discussion the teacher can use the questions proposed in the material TM5-S2-RM-05_Discussion questions_ teacher. If both policy briefs have been discussed, two students should briefly summarize the content, goal, target audience, knowledge base, and methods used in each policy brief. Each group should summarize the central points they discussed in the groups (about five minutes for each group).

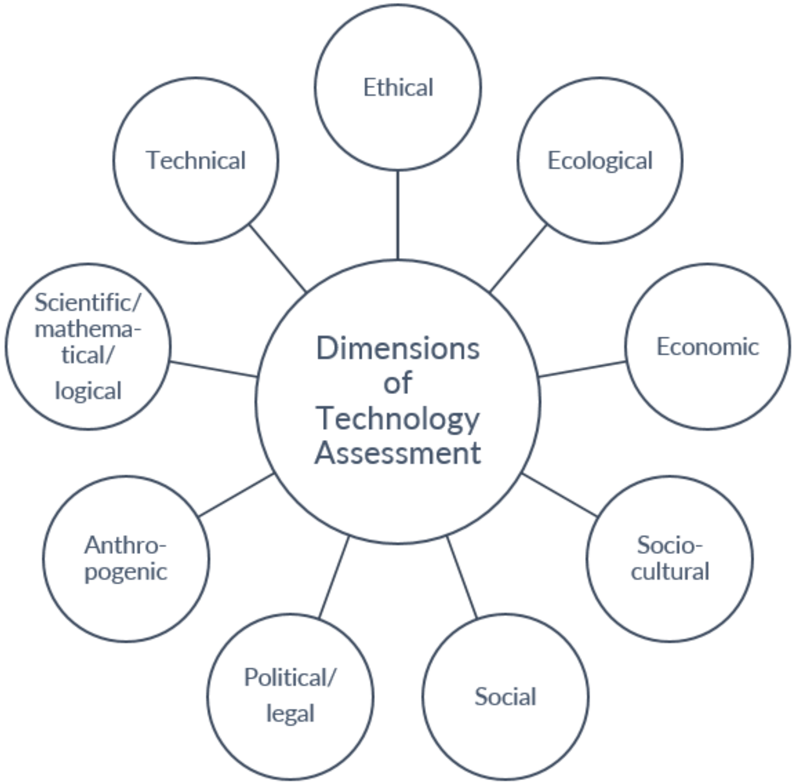
Activity 4:
Lecture

Methods	Lecture using PowerPoint slides
Keynotes	None
Materials	**TM5-S2-RM-06_ppt_dimensions TA**
Required accessories	Computer, projector
Time allocation	15 min
Learning outcomes	The students learn about the dimensions that are relevant in technology assessment processes. During the lecture, students may edit their notes regarding which dimensions were addressed in the policy brief they analyzed.

Content of the lecture

Dimensions of technology assessment – The componence model of TA suggested by Scheffczik

New technologies may impact societies in various ways. Or to put it the other way around: comprehensive technology assessment requires thorough consideration of the impacts that innovative technologies could have in different areas of society. The German social scientist and economist Walter Scheffczik created a competence model of technology assessment that highlights nine dimensions that should be considered when evaluating technologies. The model is not designed to be comprehensive and may be supplemented and modified if necessary. It is obvious that technologies affect these dimensions differently in each specific case and overlaps can occur between the dimensions (Scheffczik 2003). However, TA reports or briefs usually focus on some of these aspects (see the documents used in activity 2 of this session).



ANTHROPOGENIC DIMENSION

The anthropogenic dimension refers to the impact technology has on humans. The compatibility of humans and technology is of particular importance here, and this includes people's mental and physical well-being. A striking example of this dimension is the use of personal computers in many areas of the workforce and their impact on the eyesight and posture of employees. Another example is the impact of military drones on the people who operate them. Even though drone operators are not physically involved in combat operations, mental health problems among operators have been reported in the context of the US drone program (Ross 2016). An energy technology example that fits within this dimension is the debate about infrasound generated by wind turbines, although so far the effects of infrasound have not been scientifically proven (McCunney et al. 2014).

ECOLOGICAL DIMENSION

The environmental dimension deals with questions such as the environmental impact of harmful emissions caused by the use of certain technologies. The environmental dimension deals with topics such as pollution of the soil, water, groundwater, and air (e.g. emissions from brown coal power plants or from mining activities for the extraction of fossil fuels like coal, uranium, and oil). It also incorporates questions about the preservation of flora and fauna (e.g. biodiversity in the context of crop production for bioenergy), about ways of disposing of technological byproducts (e.g. nuclear waste), and about the protection of human health (e.g. the dangers of trace elements in the air or groundwater).

SOCIAL DIMENSION

In contrast to the anthropogenic dimension, which deals with the compatibility of technology with humans on a biological level, the social dimension examines the relationship between technology and humans as social beings. Therefore, the social dimension focuses on the social compatibility of technology. A striking example for illustrating this dimension is the modification of our communication through the development of smartphones and social media networks. Another example is the use of robotic technologies in old-age care, which will likely spread further into society in the future and impact the social relationships of older and diseased people (Martinez-Martin, del Pobil 2018).

SOCIO-CULTURAL DIMENSION

The socio-cultural dimension looks at questions regarding daily practices and consumption patterns and how they change over time. Changes are often caused by technological developments and innovation. For instance, the invention of the automatic washing machine radically changed clothes washing practices. Washing became easier. Together with other trends such as the declining cost of clothing, this led to an increasing amount of laundry, energy and water consumption (Shove 2003). Investigations into previous technological developments and their consequences for social practices and consumption patterns form the foundation for assessing current technological developments. This makes it possible to understand developments and trends and identify appropriate measures for influencing developments.

TECHNICAL DIMENSION

The question of whether a technology achieves its desired effects depends largely on the functionality of the technical object. Within the technical dimension, technical usability and technical efficiency are the key assessment criteria. Technical usability describes the extent to which a technological device corresponds to the users' needs and provides suitable functions to meet those needs. Technical efficiency is closely related to the economic dimension and focuses particularly on the energy efficiency of the technology.

SCIENTIFIC/MATHEMATICAL/LOGICAL DIMENSION

This dimension is indispensable when evaluating technologies. It is strongly linked to the technical dimension, but focuses on the laws of nature. These laws are used to examine the technical feasibility of a technology. Within this dimension, objective evaluation criteria are defined on the basis of scientific variables such as torque, tension, voltage, and other variables that are relevant for the functioning of the respective technology.

ECONOMIC DIMENSION

The economic dimension includes questions about the economic nature and impacts of a technology. From a business point of view, a technology is profitable if the recoverable revenues from the technology are higher than the acquisition and fixed costs over the long term.

ETHICAL DIMENSION

Technology assessment aims to support the normative process of rulemaking. However, decisions based on TAs are only deemed acceptable by the broader public if the TA recommendations are morally acceptable and ethical. The ethical dimension therefore plays a crucial role in technology assessment. A central question in the ethical dimension is whether things that are scientifically and technically possible should actually be realized (Woopen, Mertz 2014)). Technologies can challenge a society's existing moral order. In order to identify, classify and consider such challenges, the people conducting the assessment must have knowledge about ethical concepts and traditions. TA without ethical competence tends to reduce ethical considerations to questions of acceptance and treat values as external data. A major objective of the ethical dimension is to reveal the different value systems of different actors. Specific ethical expertise is essential for the ethical analysis and assessment of the various potential consequences new technologies (i.e. the possible effects of their development and implementation). 'Ethical expertise' refers to an ability to reconstruct, classify and evaluate normative arguments and frameworks, as well as to consistently apply an ethical theory. Ethical issues most prominently come into play in biomedicine and genome research.

POLITICAL/LEGAL DIMENSION

With the help of laws, enactments, bans and regulations, the state exercises considerable influence over technological developments and research. States must prioritize technological developments that ensure political stability, economic growth, employment, environmental protection, and social justice. Existing legal requirements, such as environmental assessment procedures, have to be taken into account in TA processes. TA can (and should) deliver recommendations on how to modify political measures and legal requirements in order to regulate new technologies in a way that allows for welfare of the society.

Session 3:

Actors and methods of technology assessment

a) Session objectives

This session introduces the methods and techniques of TA. Students will become familiarized with the roles different actors play in TA processes. The session focuses on system analysis approaches that aim to identify the impacts of innovative technologies, including their impacts on society, the environment and the economy. The social life cycle assessment (sLCA) method will be introduced as an example.

b) Session scope

Actors in TA processes

» *Technology assessment processes can vary widely depending on the stated objectives.*

It is almost impossible to make any generalization about which actors should be integrated in TA processes. In the 1980s TA became institutionalized in many European countries. In addition to TA institutions, there are three groups of actors that are relevant to TA processes: politics, science, and society.

Methods of TA

Since technology assessment emerged in the 1970s, numerous methods have been developed to fulfill its diverse functions and goals. These methods address the actors in TA processes to different extent. Grunwald groups the various methods and approaches into five categories that reflect the different functions of TA (see session 1 of this module) (Grunwald 2010): system analytic approaches, prospective approaches, discourse analytical approaches, participatory approaches, communicative approaches.

Social life cycle assessment

The method of social life cycle assessment will be discussed in more detail within this session. It belongs to the system analytic approaches. An LCA evaluates the technology from the cradle to the grave, including the production of the technology itself, the production of the raw materials needed to make the technology, the use and consumption phase of the technology, and finally its disposal and potential recycling.

» *For a comprehensive LCA, the entire lifecycle of the technology must be taken into account.*

In addition to economic and ecological aspects (classic LCA), more recent approach of social LCA (sLCA) also takes into account societal issues such as child labor and inhumane working conditions (Dreyer et al. 2006; Fan et al. 2015).

The sLCA method has some limitations. Fan et al. (2015) highlight four major limitations of sLCA: 1) There is no accepted definition of human well-being, which is the central category of social impact, 2) it is difficult to find and select respective indicators in order to quantify social impact, 3) the focus of the assessment affects the type of data required (site-specific versus generic data), and 4) there is no appropriate method for quantifying social impacts. Major critiques of sLCA emphasize its reductionist approach, as it reduces the social impacts of technologies and economic activities to a few numbers and consequently excludes diverse aspects that can hardly be measured.

The session ends with an introduction to the UNEP guidelines for social LCA (UNEP 2009). The subsequent activity is based on these guidelines. The UNEP scheme is probably not perfect. However, it provides a systematic approach that allows actors with diverse perspectives on a specific product (NGO, producer, politicians etc.) to come together and to bring their perspectives into the definition of categories for evaluation.

c) Pre-reading

No.	Author and title	Description
1.	Van Eijndhoven, Josée. Technology Assessment: Product or Process? „Technological Forecasting and Social Change” 1997, Vol. 54, Issue 2-3. DOI: 10.1016/S0040-1625(96)00210-7	See required reading for session 1.
2.	Freudenburg, William. Social impact assessment. „Annual Reviews Sociology” 1986, Vol. 12. DOI: 10.1146/annurev.so.12.080186.002315	This article reviews the literature on social impact assessment (SIA), a field that emerged during the 1970s as a response to new environmental legislation and can be seen as a precursor to sLCA. From a sociological perspective, Freudenburg explains the relevance of taking into account social impacts and discusses their characteristics and challenges. Many of these are relevant for TA in general and for sLCA in particular.

No.	Author and title	Description
3.	Fan, Yi et al. 2015. A Review of Social Life Cycle Assessment Methodologies. In: Muthu, Subramanian (ed.): Social Life Cycle Assessment. Springer, Singapore.	The authors summarize state-of-the-art sLCA methods.

d) Class activities

Activity 1: Lecture

Methods	Lecture
Keynotes	None
Materials	**TM5-S3-RM-01_ppt_actors & methods of TA and sLCA**
Required accessories	Computer, projector
Time allocation	55 min
Learning outcomes	Students will acquire knowledge about actors and their roles in TA processes, (categories of) TA methods, and the sLCA method.

At first the teacher can give a short introduction into the content of this session (Slide 2, TM5-S3-RM-01_ppt_actors & methods of TA and sLCA). He or she can then start with the lecture.

Actors in TA processes

Technology assessment processes can vary widely depending on the stated objectives. It is almost impossible to make any generalization about which actors should be integrated in TA processes. In the 1980s TA became institutionalized in many European countries. Two such European institutions are the POST and the ITA, which published the policy briefs that were discussed in the last session. Van Eijndhoven (1997) highlighted that in the 1980s, six parliamentary technology assessment organizations were established in places such as France, the Netherlands, Germany, and at the EU level. Each organization has its own individual structure, is embedded into the political system in a specific way and follows specific goals. In addition to TA institutions, there are three groups of actors that are relevant to TA processes: politics, science, and society.

POLITICS

One of the central goals of technology assessment, particularly in European countries, is to provide advice for decision-making and the establishment of political strategies in the field of science, technology and innovation policy. TA aims to provide 'objective' information about new technologies and potential unintended and unfavorable consequences, as well as to contribute towards the development of strategies for technology governance and innovation programs. Hence TA primarily addresses policymakers and political actors. TA translates scientific results into policy relevant conclusions for the benefit of this audience (Van Eijndhoven 1997). In the last session, the students learned that policy briefs are primarily aimed at politicians and policymakers.

SCIENCE

Technology assessment needs support from the scientific disciplines. Scientific contributions are required for many issues, e.g. to investigate the technical characteristics of proposed systems, regulatory issues, and social patterns of acceptance and conflict or innovation mechanisms. In the context of TA, scientists have to deal with tensions related to the freedom of research. The most significant tension exists between the autonomy to define research topics in line with the criteria of the scientific community, and taking on a political role by advising policy. Remind the students about the second session of this module: the policy briefs addressed a variety of different issues. Scientists were actively involved in putting together those briefs. However, scientists also played an important role in the studies underlying the policy briefs.

SOCIETY

Societal actors (for example NGOs, unions, churches, city authorities, the general public, etc.) often criticize the unintended and unfavorable impacts of technology development. Societal actors and their perspectives are of specific relevance to the requirement that technology assessment should have a democratizing effect on technology. Some authors even argue that democratizing technology is the central task of technology assessment (Grunwald 2010). In order to achieve this aim, firstly, there needs to be communication between democratic institutions and the scientific community. Secondly, knowledge transfer from science to society is seen as a precondition for communication and democratic debate (Grunwald 2010). The question of how society can best participate in science and technology governance has been intensely debated for at least two decades and is still an important issue (Hennen 2012). Participatory methods seek to combine the perspectives of experts and laypersons in technology assessments, aim to use more inclusive approaches of appraisal, and are seen as the best way of democratizing science and technology (Ely et al. 2011; Hennen 2012; Guston, Sarewitz 2002). Participatory methods are referred to as "constructive technology assessment" (Rip et al. 1995), "participatory technology assessment" (Klüver et al. 2000), "real-time technology assessment" (Guston, Sarewitz 2002) and other similar terms. However, participatory approaches should not be misunderstood as approaches that facilitate greater participation in political decision-making; instead, their main focus is to reveal the diversity of perspectives on technology development (Hennen 2012).

Methods of TA

Since technology assessment emerged in the 1970s, numerous methods have been developed to fulfill its diverse functions and goals. Grunwald groups the various methods and approaches into five categories that reflect the different functions of TA (see session 1 of this module) (Grunwald 2010).

SYSTEM ANALYTIC APPROACHES

System analytic approaches aim to develop an understanding of the complex interdependencies of technology development, the use of technologies, the impacts of technologies on the natural environment and society, as well as ethical considerations. Such methods include LCAs (and sLCAs), input-output analyses, and risk analyses. The policy brief about energy-efficient buildings (see session 2) takes this perspective: it aims to explore the interdependency between technological infrastructure (energy-efficient buildings) and the users of that infrastructure.

PROSPECTIVE APPROACHES

Prospective approaches are used to estimate the impacts of technologies and involve analyses related to uncertainties and non-knowledge. The extrapolation of trends, model-based simulations, and scenario analyses are some of the methods in this field. The knowledge presented in the policy brief on tidal energy barrages (see session 2) relies on computer modelling as a method for predicting future developments.

DISCOURSE ANALYTICAL APPROACHES

Discourse analytical approaches aim to reveal and map the arguments and positions that are raised during technology conflicts. This can be done using interview methods, media analyses, and the value tree approach – to name just a few.

PARTICIPATORY APPROACHES

Participatory approaches are used to integrate diverse perspectives into processes of technology assessment. The well-established methods are consensus conferences, focus group discussions, and mediation.

COMMUNICATIVE APPROACHES

Finally, communicative approaches are used in technology assessment to reach the public and involve audiences in the discourse on technologies. The application of these methods depends on the context, objectives and specific requirements of the technology assessment procedure. They are part of complex processes of knowledge integration.

Social life cycle assessment

Technology assessments based on the life cycle assessment method (LCA) can help to achieve sustainability-oriented technology designs (Grunwald 2010). An LCA evaluates the technology from the cradle to the grave, including the production of the technology itself, the production of the raw materials needed to make the technology, the use and consumption phase of the technology, and finally its disposal and potential recycling. For a comprehensive LCA, the entire lifecycle of the technology must be taken into account. In addition to economic and ecological aspects (classic LCA), more recent approach of social LCA (sLCA) also takes into account societal issues such as child labor and inhumane working conditions (Dreyer et al. 2006; Fan et al. 2015).

The discussion about how to handle social and socioeconomic criteria in life cycle assessments started around the mid-1990s. The field of social impact assessment (SIA) can be understood as the precursor to sLCA. It emerged in the US in the 1970s in response to new environmental legislation designed to examine the social impacts of industrial activities. The rise of social impact assessment (SIA) can be interpreted as "a response to society's increased concern with environmental degradation and the social implications of technology" (Freudenburg 1986). SIA is both part of science and part of political decision-making. It aims to assess a broad range of impacts caused by technologies (mostly infrastructural projects) that might be experienced by a broad range of social groups (Freudenburg 1986). Freudenburg reveals that the “scientific genealogy of SIA can be traced back to the earliest days of sociology, to the concerns of Toennies and Durkheim, for example, with the social consequences of the Industrial Revolution” (Freudenburg 1986). As tool for technology assessment, SIA’s main role is to provide information based on sound scientific research that can be used to inform political decision-making (Freudenburg 1986). SIA became a component of the policymaking process and is intended to be anticipatory, i.e. a planning tool focused mainly on possible unintended consequences of technological developments. However, in practice, SIA approaches focus mostly on the impacts actually experienced after developments have taken place: “empirical SIA work has focused on relatively specific construction projects, particularly large-scale energy development projects in rural areas” (Freudenburg 1986).

In the mid-1990s a debate started about how the social impacts of technologies, production systems and economic activities could be incorporated into the LCA method. The social life cycle assessment was born: “social LCA aims at facilitating companies to conduct business in a socially responsible manner by providing information about the potential social impacts on people caused by the activities in the life cycle of their product” (Dreyer et al. 2006). Impact assessment must be quantifiable according to ISO standards. Therefore sLCA has to be based on quantifiable indicators. Quantification methods used for sLCA vary according to its objectives: single products (use of company data is appropriate) vs. product families (must rely on general socioeconomic data). The question of how social impacts can best be quantified is a controversial topic. The accessibility of data is a crucial issue for sLCA, because site-specific data (e.g. company data) is hard to obtain. As a result, assessments typically use generic data from national censuses or public surveys (Dreyer et al. 2006; Fan et al. 2015).

Social life cycle assessment

An LCA evaluates the technology from the cradle to the grave, including the production of the technology itself, the production of the raw materials needed to make the technology, the use and consumption phase of the technology, and finally its disposal and potential recycling.

- Life cycles of products involve material, energy and economic flows.
- Indicator based method – nowadays important indicators in LCA for example CO2 emissions, energy needed, typical indicator in sLCA for example occupational safety, child labor.
- Example: Evaluation of cars driven by combustion engine and electronic vehicles.
- Production process in the CO2 balance – often not mentioned in electric cars; Frequently assumed full utilization of vehicles, although reality deviates from e.g. compared to train vs. individual travelling.

Problems of social life cycle assessment

Fan et al. (2015) highlight four major problems of sLCA: 1) There is no accepted definition of human well-being, which is the central category of social impact, 2) it is difficult to find and select respective indicators in order to quantify social impact, 3) the focus of the assessment affects the type of data required (site-specific versus generic data), and 4) there is no appropriate method for quantifying social impacts. Major critiques of sLCA emphasize its reductionist approach, as it reduces the social impacts of technologies and economic activities to a few numbers and consequently excludes diverse aspects that can hardly be measured. Nevertheless, various sLCA methodologies have been developed over the past decades (Fan et al. 2015; Dreyer et al. 2006; Siebert et al. 2016).. The methodologies differ in relation to their spatial focus, definitions of systems boundaries and social well-being, the indicators used to represent social impacts, as well as the methods used for data collection. Some methods rely on data that is available from national surveys and statistics, while others use data collected specifically for sLCA using surveys and interviews with stakeholders who are relevant for the overall question and spatial context. The UNEP provides guidelines for the sLCA of products (UNEP 2009).

UNEP Guidelines for Social Life Cycle Assessment of Products

Short Description
“The proposed code is the first international voluntary guidance document to assess social impacts along the life cycle of products in a global context. It provides an analysis and description of the current practice of social Life Cycle Assessment (S-LCA) as well as a methodology and suggests social impact categories linked to key stakeholders groups such as workers, consumers and local communities.”

Background

- “Until now, no commonly accepted methodology for assessing internalities and externalities of the production of goods and services for “people” and “profit/prosperity” was available. That is precisely what the tool presented in these Guidelines wants to deliver (see red part of Figure 1): on the basis of the most current and state of the art methodological developments it formulates guidelines on how to assess a product based on social and socio-economic indicators”.
- Along with the corporate social responsibility debate over the last two decades, there has been growing demand for direction and guidance on incorporating social issues into sustainability strategies and impact assessments.
- In 2006 life cycle experts acknowledged the necessity to offer a complementary tool to assess product’s social life cycle aspects. This publication is a UNEP contribution.
- This document describing possible Guidelines for a Social Life Cycle Assessment comes out of this broader discussion and is the result of several years of collaboration among an impressive group of life cycle experts.

UNEP Guidelines for Social Life Cycle Assessment of Products

Content and aims

- Guidelines for Social Life Cycle Assessment of Products provides a map for stakeholders engaging in the assessment of social and socio-economic impacts of products life cycle.
- Context of the scheme is sustainable production and consumption (e.g. production of cotton-T-shirts).
- The sLCA guidelines presents key elements to consider ad provide guidance for the goal and scope, inventory, impact assessment and interpretation phases of a social life cycle assessment.
- The guidelines provide the necessary basis for the development of databases for continued assessment and socio-economic conditions of production and consumption.
- The publication aims to provide an approach that allows for the internalization of environmental and social externalities in production.

Target group(s)

- It should help stakeholders, notably manufacturers (companies), to effectively and efficiently engage to first, know about the effects a product have and second, to improve social conditions socio-economic conditions of production and consumption.

UNEP-Scheme of social life cycle assessment

The lecture ends with an introduction to the UNEP guidelines for social LCA (UNEP 2009). The subsequent activity is based on these guidelines. The UNEP scheme is probably not perfect. However, it provides a systematic approach that allows actors with diverse perspectives on a specific product (NGO, producer, politicians, etc.) to come together and to bring their perspectives into the definition of categories for evaluation.

Subcategories are the basis of the sLCA guidelines proposed by UNEP – they are the items on which justification of inclusion or exclusion needs to be provided.

- The subcategories are socially significant themes or attributes.
- Subcategories are classified according to stakeholder and impact categories and are assessed by the use of inventory indicators, measured by unit of measurement (or variable). Several inventory indicators and units of measurement/reporting types may be used to assess each of the subcategories. Inventory indicators and units of measurement may vary depending of the context of the study.

- The UNEP-Scheme provides a comprehensive set of subcategories that have been defined according to international agreements and conventions. On national level and in other contexts other categories might exist worth to be taken up. In so far the list of subcategories represent minimum of criteria.
- Different contexts will represent different challenges and will need varying levels of assessment and additional subcategories.

Stakeholder categories: A stakeholder category is a cluster of stakeholders that are expected to have shared interests due to their similar relationship to the investigated product systems. The UNEP guidelines suggest five main stakeholder categories:

1. Workers/employees,
2. Local community,
3. Society (national, global),
4. Consumers (end-consumers but also consumers related to each step of the supply chain),
5. value chain actors.

If needed for an assessment in a specific case, more stakeholder categories can be added, e.g. NGOs, public authorities, etc. This allows for a more specific formulation of subcategories.

Impact categories

- Social impact are consequences of positive or negative pressures on social endpoints e.g. well-being, health, identity, etc.
- The guideline assembles social impacts into impact categories. Their main purpose is to inspire the definition of subcategories together with the stakeholder categories.

Activity 2: Brainstorming

Methods	Brainstorming
Keynotes	Ask the students to find a partner and brainstorm in pairs about the given questions. Instruct students that they remind the dimensions a TA can cover when thinking about categories for an sLCA.
Materials	**TM5-S3-RM-02_UNEP-Scheme_sLCA** **TM5-S3-RM-03_Handout brainstorming** **TM5-S3-RM-04_Handout brainstorming_teacher**
Required accessories	None
Time allocation	10 min
Learning outcomes	Application of what has been learned during the lecture.

The students are asked to come up with ideas for sLCA categories for a smart phone that is based on the UNEP guidelines for social LCA. The teaching material **TM5-S3-RM-03_Handout brainstorming** lists guiding questions for the group work. The teaching material **TM5-S3-RM-04_Handout brainstorming_teacher** lists potential answers. It is important to note that no answer is wrong.

Activity 3:
Discussion of the brainstorming

Methods	Guided discussion
Keynotes	Summarize the discussion and draw a conclusion according to the learning outcomes of the group work.
Materials	**None**
Required accessories	None
Time allocation	15 min
Learning outcomes	Reflection on the group work and a discussion of the results.

In this discussion guided by the teacher, the students should share the ideas they came up with during the brainstorming session. Possible questions for this discussion:

- *Was the task easy? Why/why not? What specifically did you find difficult?*
- *Do you have the impression that this approach/method is suitable for representing social aspects/criteria in LCA processes? Why/why not?*

Activity 4: Summary

Methods	Lecture
Keynotes	None
Materials	**TM5-S3-RM-05-ppt _last slide**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Students are reminded about what has been discussed in all three sessions of the module. They should now be aware of the value of this module to their field of study. The students should be given the opportunity to share their opinions about the module (e.g. whether their expectations have been met).

The teacher concludes the course by reminding the students about the key points of the module and the insights gained during the exercises and discussions.

Assessment methods and final assignment

In order to assess the achievements of the students, each student has to write an essay of about 2-3 pages on an issue chosen from the course topics. The essay shall be structured in three parts:

1. Hypothesis related to the issue chosen.
2. Arguments for or against the hypothesis.
3. Conclusion and synthesis.

The teacher has two possibilities: either each student can choose any topic related to the course. Or, the teacher defines a topic that all students have to address.
The essay is the basis to evaluate and graduate students' achievements. Evaluate: overall structure, language, originality of the ideas, and correctness of facts.

Glossary

Discourse analysis	Discourse analysis is a generic term for the social and humanistic analysis of discourse phenomena. Such discourse phenomena can be written, vocal, or sign language, or any other communicative event.
Freedom of research	Freedom of research is the principle, that scientist are free in their inquiring questions, in their methodical procedure (as far as it does not violate any laws) as well as in the evaluation and dissemination of their research results.
Governance	Governance includes all of the processes of governing. This can be actions undertaken by the government of a state, by a market or by a network over a social system (such as families, tribes, formal or informal organizations, a territory or across territories). Different types of governing are for example the laws, norms, power or language of an organized society.

Institutionalization	Institutionalization is the process of becoming a permanent or respected part of a society, system, or organization. It regulates societal behavior and establishes thereby safety above norms and rules in interpersonal relations within a special context.
Social impact assessment / SIA	Social impact assessment is the process of identifying and managing the social impacts of technologies.
(Social) life cycle assessment / (s)LCA	Life cycle assessment is one specific methodical approach within the system analytical approaches of technology assessment. An LCA evaluates the technology from the cradle to the grave, including the production of the technology itself, the production of the raw materials needed to make the technology, the use and consumption phase of the technology, and finally its disposal and potential recycling. The social LCA (sLCA) also takes into account societal issues in addition to economic and ecological aspects.
System analysis	System analysis is the process of breaking down a system into its component pieces for the purpose of the studying how well those component parts work and interact to accomplish their purpose.
Technology assessment / TA	The research field of technology assessment is a branch of technology philosophy and sociology. It originated in the 1960s in the US and spread throughout Europe from the 1970s. Technology Assessment deals with the observation and analysis of trends in science and technology and related societal developments, in particular the assessment of opportunities and risks.
Technology assessment – dimensions of	The German social scientist and economist Walter Scheffczik created a competence model of technology assessment that highlights the following nine dimensions that should be considered when evaluating technologies: the anthropogenic dimension, the ecological dimension, the social dimension, the socio-cultural dimension, the technical dimension, the scientific/mathematical/logical dimension, the economic dimension, the ethical dimension and the political/legal dimension.
Technology assessment – functions of	TA has several functions. Armin Grunwald describes the following five functions as the most important ones: the reflection about technological impacts, political and societal consultation, the identification and management of conflicts, the democratization of technology and societal governance of technology.
Technology assessment – methods of	There are various methods to use when doing technology assessment. Armin Grunwald groups the various methods and approaches into the following five categories: system analytic approaches (e.g. sLCA), prospective approaches (e.g. model-based simulations), discourse analytical approaches (e.g. media analysis), participatory approaches (e.g. consensus conferences) and communicative approaches (e.g. science theater).
Technology assessment– parliamentary	Parliamentary technology assessment is a political instrument that supports the design and regulation of technology. It first became institutionalized in the United States in 1972.

Attachment: Syllabus

1. Name of the Teaching Module

Technology Assessment. An approach for organizing societal discourse on innovative energy technologies.

2. Brief description of the subject matter

The long-term consequences of technical developments are often hard to predict. In an attempt to address this problem, an interdisciplinary approach for assessing technologies was developed during the 20th century. Technology assessments involve the analysis of possible scenarios regarding the opportunities and risks of technical developments, as well as the provision of advice for technology policymakers and society more generally. In this module students will learn about the historical development of technology assessments, the current role of parliamentary technology assessments in Western societies, as well as the basic principles of technology assessment. Students will acquire knowledge about the current practices involved in technology assessment, its basic assumptions and main goals. The last session focuses on the methods used to fulfill the diverse functions and aims of technology assessment. Particular emphasis is placed on system analysis approaches that are designed to identify the economic, social and environmental impact of emerging technologies. The module sessions link theoretical and methodological aspects with practical examples from energy research and energy technology development.
All areas of our life are intertwined with and permeated by technologies. They are ubiquitous and shape our lives at home and at work. They affect our health, the ways we interact with others, and our relationship with nature (Bijker, Law, 1992). For centuries, technological development has facilitated and benefited our lives and increased our well-being. However, technologies have also caused serious environmental problems and negatively impacted societies and our social lives. Since the 1970s, concerns about the negative consequences of technological development have increasingly triggered public debates and large technology projects have been met with public resistance, for example (Van Eijndhoven 1997). Such debates revealed that different groups of actors held diverging views about the potential effects of technologies.