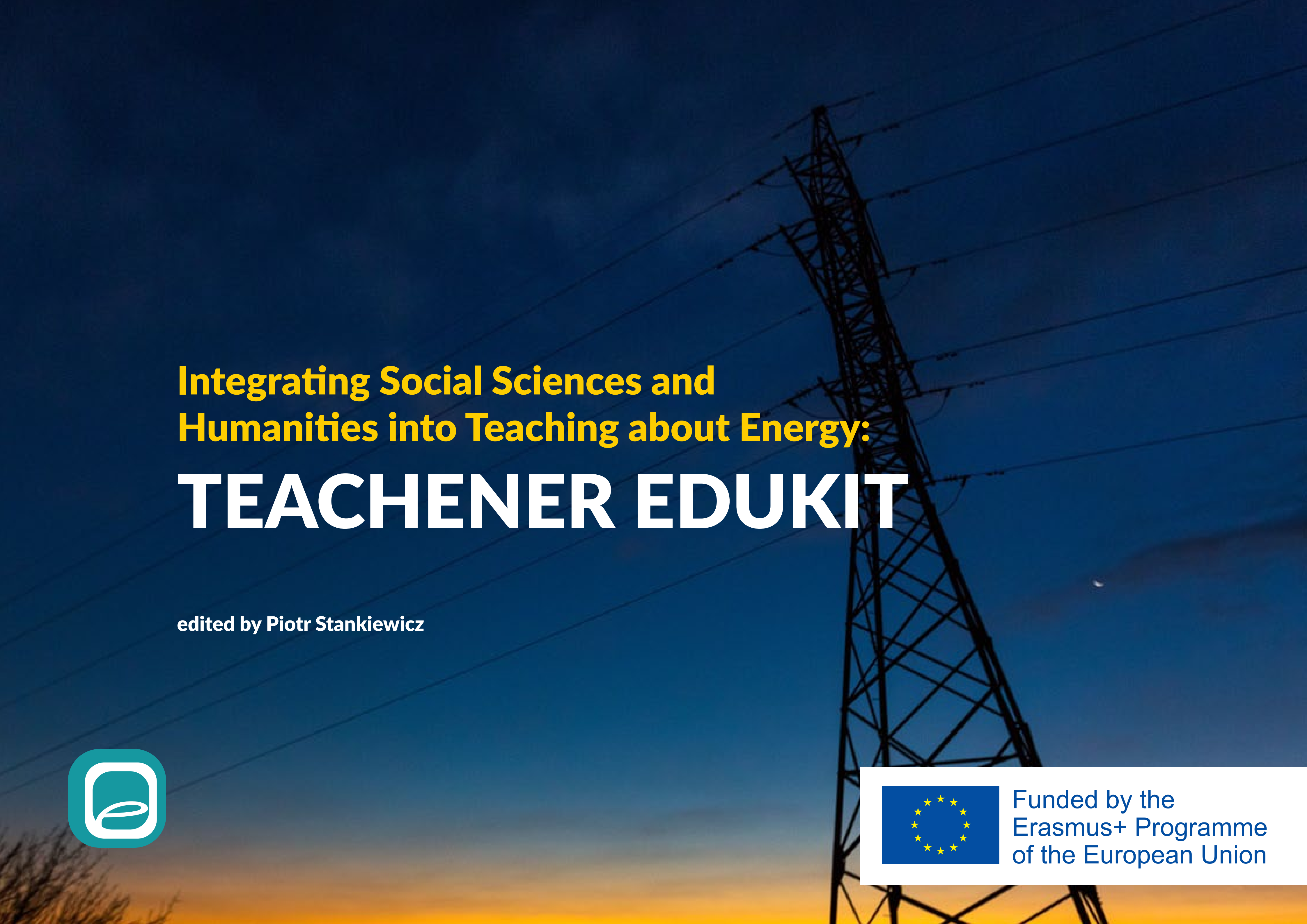

Integrating Social Sciences and Humanities into Teaching about Energy:

TEACHENER EDUKIT

edited by Piotr Stankiewicz

Funded by the Erasmus+ Programme of the European Union

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Preface

Social sciences and humanities – what role do they play in teaching about energy?

Piotr Stankiewicz, Krzysztof Tarkowski

The dominant view on science, until the middle of the 20th century, was that it is a neutral enterprise, that it is a selfless search for truths about the world, and that technology is simply an equally neutral application of its achievements. This was a view typical of the Enlightenment's belief in technological progress. However, further development of science has shown that its relationship with values and society is far more complex than one might think at first glance. The beginnings of critical reflection on science and technology can be traced back to the turn of the 19th and 20th centuries, for example to such thinkers as the Hungarian sociologist Karl Mannheim or the Polish microbiologist Ludwik Fleck, who pointed out that science is not only a cognitive undertaking, and technology is not a trouble-free application of its achievements. However, the critical reflection on the role of science and technology flourished in the second half of the 20th century, as a response to the growing interference of science in the social substance and the related controversies, i.e. multiple problems with nuclear energy or GMOs. The answer to the growing number of controversies was the emergence of a research area known as science and technology studies (STS) around the 1960s. It is an umbrella term, under which one could find many different fields of research e. g. the social construction of technology and history of technology, sociology of scientific knowledge and scientific institutions, or social understanding of science. There are also areas that are more loosely linked to the STS like sociology of environment, development studies, new social movements theory, ethics and philosophy which have brought forward many fruitful insights into different aspects of energy development (see e.g. Callon et al., 2009, Gross, Heinrichs, 2010 or the special issue of the journal Energy Research & Social Science "Energy Transitions in Europe" (vol 13/2016)). Despite the great diversity between these areas in terms of subject matter, methodology, research tools and concepts, their common denominator is that they perceive **science and technology as deeply rooted in values and society.**

The TEACHENER project which stands for Integrating Social Sciences and Humanities into Teaching about Energy is based on the tradition of science and technology studies. This project covers two important issues. The first is a **critical reflection on energy in the contemporary world,** especially in the context of values embedded in political decisions and its social consequences. The second is to make this perspective more accessible to future engineers. Energy is a resource of strategic importance and hence plays a significant role in today's social, political and economic world – and its role is increasing steadily- debates about CO2 emissions, global climate change, diminishing conventional resources or controversies around nuclear energy or shale gas. **Energy issues have transformed from solely technical, engineering issues to complex socio-technical phenomena on the border between technology and society.** Some researchers have acknowledged the fact that "science and technology cannot be deployed without regard to their environmental and social implications or 'side-effects'" (Hammond, 2000). As Miller et al. state (2013: 135-136), "Efforts to transform energy systems involve changes (...) not only to energy technologies and prices but also to the broader social and economic assemblages that are built around energy production and consumption. (...) Energy debates need to be informed by robust empirical and theoretical inquiries into what current and future energy changes will mean for diverse groups of people across the planet".

Production, provision and technological development of energy enables European states in an increasing extent to mix traditional energy resources, linked to the industrial past, with nuclear energy and renewable resources, what changes the way how different states deal with the transition to a low carbon society. This happens in the reflexive context, where the persisting demand for energy goes hand in hand with the awareness of environmental and social risks. From the STS point of view, **political issues relating to future technological solutions and energy policies cannot be limited to technical expertise alone but must take into account the social context.** While it is uncertain what this shift means for the transformation of political decision-making about energy, the implications for the scientific ethos are obvious. It seems to be no longer tenable to view the research as accomplished in the seclusion of laboratories and detached from the impact of energy technologies on social systems. If science is to assist political reason convincingly, then competences have to be built, which allow conceiving the technical and the social as two interlinked phenomena. Should the European scientific community draw on the benefits of complementary expertise with possible unforeseen synergy effects, then it has to set out for a mission of transdisciplinary learning and education.

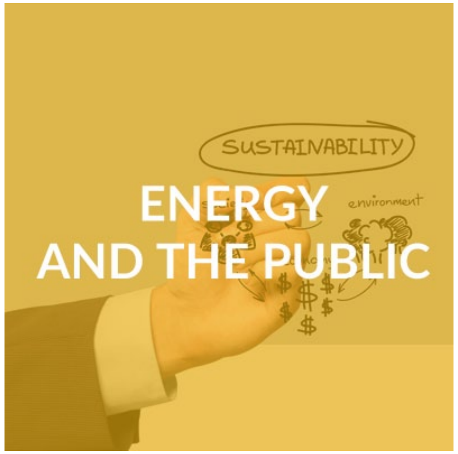
Realizing the embedding of contemporary transformations and controversies related to energy in social issues, the TEACHENER project aim was to create an EDUKIT, the introduction to which is the presented book. The EDUKIT is a complex set of ready-to-use, innovative Teaching Modules covering various topics associated with social aspects of energy for educating Master and PhD students at technical higher education institutions. It is meant to **fill the gap between social sciences and humanities and**

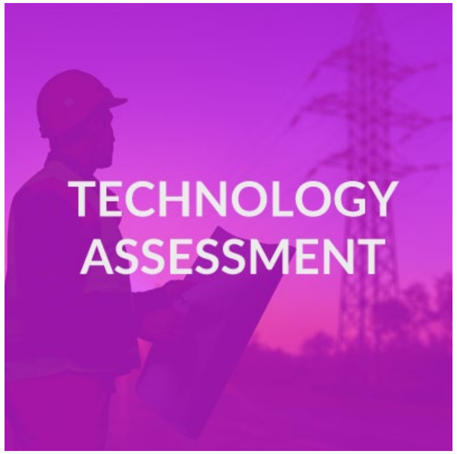
energy teaching at universities in Europe, by transposing social sciences and humanities knowledge to the domain of higher technical education. Innovative educational practices, presented in this book, provide the graduates of technical energy studies with interdisciplinary skills, knowledge and competencies in social sciences and humanities, enabling them to better respond to the needs of the labour market related to the shift to knowledge society and a fair energy transition with new or adapted job profiles. In this context, higher education in engineering and energy systems needs to be set in a broader perspective and context, where engineers are expected to have skills and competences also in the social and ethical dimension. There are at least two reasons for this idea.

Firstly, these changes have also resulted in the **change of expectations towards graduates from technical higher education institutions:** they are expected not only to be well-trained engineers but also to have skills and competencies in social aspects of energy issues: understanding of energy policies, analysing possible development scenarios, organising public communication programmes, mitigating conflicts and local protests. The German experience with energy transition has clearly shown the importance to have knowledge on societal processes available when it comes to siting innovative renewable energy technologies (and infrastructures).

Secondly, **conventional ways of energy teaching insufficiently take into account the social aspects of energy issues.** Energy teaching is still dominated by its technological facet and the broad social dimension of energy is marginalized or completely absent. The only exception here is economy, which has already found its way into thinking and teaching about energy. Moreover, even if social aspects are included in teaching curricula at technical universities, they are present mainly in a form of additional courses in “sociology” or “philosophy” in general, which are taught by external teachers with no or little experience in energy research. As Benjamin Sovacool stresses, “social science-related disciplines, methods, concepts and topics remain underutilized in contemporary energy studies and much of what is produced is irrelevant to what policymakers and businesspersons consider important” (Sovacool, 2014). With relation to nuclear energy, this problem has been explicitly raised in a public declaration published after RICOMET conference in 2015 (*Risk perception, communication and ethics of exposure to ionising radiation)*. Its signatories appealed for “the incorporation of activities to broaden the social and ethical aspects taken into account during core scientific and nuclear research and development. Shaping R&D pathways in socially desirable ways implies transdisciplinary methodological approaches and activities to build strong societal justification.” (Ricomet, 2015).

TEACHENER project partners undertook the task to prepare the **EDUKIT – an integrated tool for technical university teachers, consisting of eight Teaching Modules**, each devoted to a different topic:





To prepare the EDUKIT in the way it responds to the actual needs of technical university staff, the first part of the TEACHENER project was to provide an **overview of the existing relations between social sciences and humanities (SSH) and teaching about energy at the partner higher education institutions** (see the list below) and also institutions beyond these in the partner countries. A survey was conducted in order to identify existing gaps in SSH in energy teaching as well as the needs and expectations of students and teachers in energy-related teaching programs at Master and PhD levels. Whilst graduates from technical higher education institutions are expected to be well-trained engineers and natural scientists, they are also required to have competences in social aspects of energy uses. However, energy teaching is still dominated by technological aspects and the broad social dimension of energy is marginalized. National workshops were held with representatives from public administration, academia, businesses and research institutions in the four TEACHENER countries to discuss and define the needs and expectations of businesses and public administrations regarding the education of technical energy studies graduates.

In Teaching Modules (TM) 1, 2, 3 **we started by presenting the basic perspective on the issue of relations between energy and society.** We all depend on continuous energy supply in our day-to-day activities. As people living in the EU states, we take it for granted that a source of electricity will be there whenever we need it. It is a considerably less self-evident matter, how the electricity we rely on is supposed to be produced and distributed. The energy sector stands at a crossroads today and newly emerging options of energy strategies challenge the old ways of doing the business. The firsts modules address basic issues related to philosophical fundamentals and ethics of the development of the energy sector. They touch some of the issues falling into a wide and complex area of relations between society and energy innovations, such as working of science as a social institution, legitimacy of the decision-making about introduction of technologies, impacts of technologies on social relations and societies in total, exploration of consequences and risks opened up by emerging technological innovations. It is of utmost importance that technology students should be aware of the social aspects in the implementation of energy policies or projects and that they should understand the terminology, concepts and that societal challenges sometimes go hand in hand with technological challenges: e.g., regulation of distributed power generation, power accumulation, limits of power transmission, waste burden (photovoltaics, batteries) etc.

After familiarizing the students with the basic perspective of the STS on the topics related to energy, they are introduced to a wide range of issues in the field of the **social impact of technology and technology assessment (**TM 4 and TM 5). 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. Technology Assessment involves 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 students will acquire knowledge about the current practices involved in technology assessment, its basic assumptions and main goals. The main goal of these modules is to make students aware of the importance of the social criteria by assessment of the local and global social impact related to energy projects. Social Life Cycle Assessment (SLCA) methodology is presented as a tool to measure the main social impacts of energy projects through a life cycle perspective. Through it, students will be able to grasp the importance of SLCA and contextualize this methodology; students will learn the steps needed to design and conduct an SLCA and will glimpse the difficulties in defining suitable sustainability indicators in what regards social aspects and in obtaining values for those indicators.

Students then will become familiar with issues related to the **social perception of risk, risk governance and conflict management** and then with concrete examples of controversy in the energy field (TM 6 and TM 7). Public controversies and conflicts about innovative technologies are part of technology development. In many European countries and other places around the world, energy technologies—like other technologies—are often confronted with society's increasing sense of unease in relation to science and technology development. For example, the concepts of social perception of risk and risk management are presented on the example of current controversies related to smart metering. Controversies often occur at the local and regional level when it comes to large-scale energy infrastructures such as nuclear power plants, geothermal facilities or high-voltage power grids. The most visible expressions of such controversies are protest camps or demonstrations. In TM 7 a social science approach to energy conflicts is introduced. Social science analyses of conflict focus on the dimensions that come into play, such as power struggles, struggles surrounding knowledge, and the role of science and expertise in socially relevant issues like energy provision.

Finally, in the most practical module TM 8, students will be able to face nowadays trends in the **decentralisation of energy systems.** Today we are facing a significant shift from classical, central and hierarchical systems of energy production and distribution, based primarily on big size power plants powered by conventional energy sources towards local, decentralised energy systems based mainly on renewable energy sources and smart grids solutions. Decentralising the energy system is about generating energy close to where it is going to be used. The main aim of the module is to introduce students to the socio-political aspects of the decentralization of energy systems. The motivation behind these changes is not only due to technological developments or economic issues. The main driving force is wider social and political trends. Many energy supply projects that are being developed and implemented today assume an active role for consumers in energy production, who become 'prosumers', at the same time producing and consuming energy.

The 'integrated' character of the modules means, that each of them contains a full set of materials needed by the teacher to conduct the lessons: starting from the syllabus, class plans, through PowerPoint presentations and materials for students to an e-book chapter devoted to the topic covered by the given Teaching Modules. The chapters are contained in this e-book and offer both a general description of the problems discussed and a detailed presentation of each session. Moreover, each Teaching Module (lasting from 4 to 12 hours) can be either used as a standalone course or be implemented into any other course conducted by the teacher. The proposed teaching sessions are created in an interactive and engaging way, making use of e.g. role-playing games and simulation exercises.

* * *

The TEACHENER project stands for Integrating Social Sciences and Humanities into Teaching about Energy and was an international project being developed under the Strategic Partnerships in Higher Education action of the Erasmus+ Programme, coordinated by the Institute of Sociology of the Nicolaus Copernicus University in Toruń, Poland. The project started in September 2016 and finished in August 2019. TEACHENER was initiated and conducted by a partnership of seven academic institutions from both social sciences and humanities and technical universities:

Nicolaus Copernicus University (Toruń, Poland)

Gdańsk University of Technology (Gdańsk, Poland)

Czech Technical University in Prague (Prague, Czech Republic)

Institute of Sociology of the Academy of Sciences of the Czech Republic (Prague, Czech Republic)

Helmholtz Centre for Environmental Research (Leipzig, Germany)

Technical University of Catalonia (Barcelona, Spain)

Marience (Barcelona, Spain)

The TEACHENER EDUKIT and other project materials are available on the website www.teachener.umk.pl

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Teaching methods

Maciej Galik

Teachener

Funded by the Erasmus+ Programme of the European Union

Teaching SSH aspects to engineers is a difficult task. The world of technical sciences is based on facts and numbers which can be quantified and categorized in a simple, formal way. Each university of technology teacher is verse in classic technical teaching methods that are based on PPT methods – present, practice, test. These methods are suitable for technical aspects but are lacking when it comes to SSH centered teaching. One needs something much more open to successfully bridge the gap between social sciences and humanities and technical sciences and teaching about energy.
Modern, novel teaching methods are an extremely important part of the TEACHENER EDUKIT package. The methods presented below have been carefully selected for each teaching module session with continuity of teaching in mind. The below descriptions are just a taste of the real teaching methodology. They are there to allow for an understanding of the basics and should be developed and practiced by each teacher at his or hers own discretion.

1. Lecture

A lecture is an oral presentation of the speakers knowledge to be conveyed to the recipient. It is a classical method which is quite demanding for both the teacher and the student. The teacher must have an excellent knowledge of the subject being presented while the student must pay close and constant attention to the speaker to uptake the said knowledge. Listed below are different variations of the lecture method which allow to enrich and stimulate the learning process.

a. Interactive lecture

An interactive lecture is done with the use of technical aids. The most common aid is a computer and projector set used to present a multimedia presentation or a video. The use of such approach is much more stimulating for the student as the audio-visual aids (when used properly) make the student more focused on the presented material. Using this method one must remember not to overdo it. It is very easy to pack a presentation with a huge mass of picture, pictograms, diagrams etc. This will cause a student's input overflow and will hinder or even stop the student from gaining any knowledge. On the other hand, one must also not use to little multimedia. Simply using a presentation, putting large chunks of text on the slides and asking students to read it will cause them to get bored very quickly. In an interactive lecture it is essential to find an equilibrium between the amount of information and the accompanying visual aids.

b. Participatory lecture

A participatory lecture is a two way communication lecture. It is designed to make the students part of the teaching process by allowing participation in a traditionally passive setting. This results in a focus shift during the lecture and increases alertness. Students take active part during the teachers speech by asking questions, deducing information, presenting their reflections etc. This approach makes the student involved in the process of teaching and learning which results in a much higher engagement of the group. Teachers should be alert when students take the floor and with positive feedback moderate the students responses to allow for proper knowledge transfer.when students take the floor and with positive feedback moderate the students responses to allow for proper knowledge transfer.

c. Presentation

The above two methods are combined in the form of a presentation. The presentation method is nothing else than a participatory lecture backed up by interactive materials. From all classic teaching methods, this method usually yields the best results. It is employed the most often by the academic community and gives a great basis for following class activities. The key to a successful presentation is its physical presentation. Even the best prepared presentations will fail to succeed if they are presented inappropriately. The teacher should not only remember the basics like facing the audience, using a confident power stance or keeping eye contact with the listeners but also focus on more advanced issues like time management, keeping a proper material to knowledge ratio and using speech structure links.
The two following subgroups are variations of the presentation method. They mainly differ in the type of interaction and should be use sparsely with specific session structure in mind.

i. interactive presentation

This type of presentation is focused mainly on the student feedback based on individual transferred knowledge chunks. It is best used in areas where concepts are introduced or discussed with a clear division which allow each chunk to be commented separately. The main advantages of this approach are the immediate verification of students' knowledge understanding and great engagement from the students. The teacher must remember about positive comments / criticism to properly moderate the students' learning process.

ii. direct presentation

A direct presentation puts the teacher and the students in opposite roles. It is the approach where it is the students who present their knowledge to be shared with the rest of the group. It is a method best employed to verify and proof students own work. The teacher should be aware of the subject at hand and consult/influence the presentation preparation process as much as possible but without reveling knowledge to be shown.

2. Discussion

Discussion methods are designed to allow for the exchange of ideas, views, knowledge and many more. By principle they require direct input from the learner and are usually preceded by an introductory excesses or are a follow up of a larger task. The main advantage of a good discussion is to share points of view, conclusions or other reflective thinking. A discussion is usually performed in a staged physical setting which allows each speaker to face the rest or at least the majority of the group. A successful discussion must have an introduction done by an expert (usually the teacher) and be summarized at the end with drawn conclusion or revision of the most profound discoveries. The below descriptions give insight into the workings of each type of discussion and briefly point to their main standout points.

a. Open discussion

The most general type of discussion. Usually started by a short presentation with an finishing open question. This question should be constructed in such a way as to spark the will to participate in the talks in the participants. Open discussions are usually best done in more active groups with topics that cause controversies among the participants. Their results are usually less predictable and should be followed closely by the teacher whose participation should be kept to a minimum.

b. Guided discussion

This type of discussion is designed to expose the learner to a variety of diverse perspectives. It allows for making assumptions and the investigation of a given topic. The form usually is constructed in blocks of steps with each step discussed subsequently. The idea is a buildup of knowledge with the possibility of reflection and moderation of the already discussed issues. As students participate in the discussion, they situate new knowledge within the context of their current understandings, thus facilitating a more thorough understanding of the course material. This is a challenging approach as the teacher may be unaware of individual student background knowledge or experience which may change the sought after conclusions.

c. Joint discussion

Joint discussion is a method based on stages. First, a given topic is discussed in groups. All groups follow the same introduction and additional argumentation. The idea is that each group may develop separate conclusions and outstanding results. It is important that each group member agrees with the achieved consensus as the group will present and possibly speak in favor of their outcome as a team. Each team should present their own findings which should be justified and properly explained. A joint discussion is a very time demanding task. It may last quite some time and should be done as a summary to a given part of the course.

d. Panel discussion

This type of discussion is one of the more sophisticated types. Its base is the discussion between four to eight persons moderated by the speaker in front of an audience. The speaker asks questions to the panel persons who answer and discuss the issue among themselves. The audience plays the role of the observer and from time to time a person from the audience may ask a question based on the findings presented by the panelists. A panel discussion is a great method for allowing the audience to have an open minded and respectful attitude towards a variety of opinions and views. It is often used to raise awareness and provide clear input for the student audience.

e. Oxford debate

The Oxford debate is an old and well known method of discussing contradictory thesis. It is often used in philosophy and humanistic sciences but can be used with great success in technical teaching. This method is based on students assuming stances of proponents and opponents. The participants are provided with the topic beforehand to study it and prepare for the discussion. Once the debate comes, the students are divided into the two aforementioned groups and a chairman who will govern the debate and assessors are selected. Under the chairman leadership groups take turn in exchanging arguments. Assessors may ask questions and follow the argumentation closely. After the exchanges of arguments are done, the chairman summarizes the debate and the assessors present their verdict as to which of the groups persuaded them. The main and obvious advantage of this method is the direct participation of all the students in the learning process. Each student takes active part and is involved in the process of the debate. Other advantages include, but are not limited to: team work practice, argument deliberation practice, public speech making and many more. The Oxford style debate is a very effective method but special attention and care must be paid in the preparation process for it to success.

3. Group work

The advantages of working in a group are without question. The possibility to work in a group creates different situation which require and train people skills, communication skills, leadership skills and many more. Group methods can be utilized in almost all classes and should be employed as much as possible as they are most advantageous to any group of students. The below mentioned methods can be used in almost all modules interchangeably and will allow the teacher to involve all students at the same time.

a. Project

The project based method is one of the most popular methods used in todays' teaching. It usually includes problem solving and actively employs the entire group in the process of solving the said problem. Project based problem solving is focused on autonomous group handling and management. It requires the group to assign roles and create a structure of responsibilities, interconnections and interdependencies which requires active participation of all team members. Usually, the project starts with the problem statements and the process of solving the given problem is up to the group. In this method, the teacher takes the role of a passive observer/moderator who monitors the progress and in times of difficulties stimulates the group with hits to solving the problem. There are many advantages of the project based method but the most important are team work and autonomy of learning. By the employment of this method students become responsible for their progress and since they are given the freedom to decide as to the course of action they become fully aware of the learning process.

b. Workshop

The workshop method is very often called the practical method. It is an approach that focuses mainly on practical aspects of knowledge practice and as such should be used in latter parts of learning courses. The idea of putting knowledge to the test is by many seen as a great way of verifying theoretical assumptions and thesis. Workshops may have many different forms and greatly depend on the subject and task of the course. Most good courses contain workshop sessions. They are used as support and training tools that allow students to foster knowledge and gain experience in a controlled environment that is suitable for practice and repetitions. Workshops can be conducted individually or in groups but the best outcomes are achieved with the combination of the two. First, individual work is carried out and then it is confronted in groups with experience exchange and decision making as to the next group employed solution.

c. Role playing games

Role playing games are a fairly new method introduced in teaching. They require special preparation and careful consideration as to the conduct. There is a variety of role playing games that can be used in the class room. Starting from simple behavioral adaptations up to group role play – role playing games can become a great tool in achieving the goal of covering a specific or a broad learning aim. Since role playing games are subject specific, the selection can be quite tricky and careful deliberations must precede the choice. It is advised to asses and point out the sought outcomes of the game and just then select the proper role-play.

i. Court roleplaying game

This type of roleplaying game is very engaging and with proper preparation and guidance can be used as a great decision and summary tool. The mechanics and structure of the court roleplaying game are similar to oxford style debate with the differences being: no assessors and judge instead of chairman. This approach requires more formalism and is best suited to active and talkative groups who enjoy a challenge.

d. Brainstorming

The idea behind the brainstorming method is to gather thoughts, arguments, points of view and ideas connected with a certain issue. Students are usually asked to toss out their thought and briefly comment on them. All thoughts are gathered and analyzed by the whole group. Brainstorming is an excellent approach when a group encounters a barrier and needs to reflect upon it. It is also frequently used to gather all individual works in a group and present them in a spontaneous, impulsive way. The teachers role is to monitor the presented aspects and intervene when the brainstorming goes off topic.

4. Other forms

There are many various forms of non-canon methods that can be employed in teaching. Most of the other forms are general, all purpose methods that will be suitable for almost any situation and task. When one wants to include a nonstandard method, he or she should remember about the goal of the exercise and what are the specific aims. With those parameters defined, it will be easy to select a method best suited for a specific classroom activity.

a. Webquest

The webquest method is a general, all purpose search method that uses internet repositories as the main source of knowledge. It is a very popular method which yields great results. The teacher should be cautious when employing this method as its improper use may provide inadequate or even false results. The things that should be remembered are: proper methodology of searching, common search engine, search argument limitation, results limitation with proper and clear criteria of selection and finally, adequate results preparation and presentation. The webquest method is the preferred method among young people who feel comfortable using internet tools but should be properly managed to yield the best results.

b. Assessment

In general, the assessment method focuses on the learners judgment to facilitate the learning process. It is a process of extrapolating bits and pieces of information from provided materials that combined together form a given knowledge chunk which can be quantified and is treated as a whole. This method is best used as support method during workshops when additional knowledge must be introduced in order for the group to continue the work. The teacher must set clear criteria which should be used and monitor are the students using them. This will allow for comparison of results among students and provide a clear outcome summary.

c. Mind map

Although a mind map is more a tool than a method, it is still regarded as one of the most effective approaches to proper knowledge gain. It is a procedure where specific key words with corresponding concepts are linked to the main topic via a network of connections and interconnections. A specific hierarchy is built with interdependencies that allow to define the relations between knowledge parts. This method allows to systematize the knowledge that has been acquired and makes it possible to define which portions have been learnt and which still require additional input. As such, they are best used as summary activities. Mind maps can also be used in revers – to define the required knowledge and allow to focus on specific issues without the need to go thru general content.

Read more

No.	Author and title	Description
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2.	EDUCON 2017, 978-1-5090-5467-1/17/$31.00 ©2017 IEEE, Oxford-Style Debates as a Tool of Engineering Learning in the Teachers Practice, p. 1868	A precise description of the Oxford debate method with pros, cons, and clear procedures.
3.	Bold, Mary. TEACHING TOOLS AND TECHNIQUES, https://www.tandfonline.com/doi/abs/10.1300/J226v01n04_07	A compendium of available methods and tools.
4.	Kochhar, S. K. Methods And Techniques Of Teaching, Sterling Publishers Pvt. Ltd, 1992	A general purpose manual for teachers describing teacher centered methods with precise hints.
5.	Borich, Gary D. Effective Teaching Methods: Research-Based Practice, Pearson; 9 edition (January 29, 2016)	This book provides an overview of student centered methods with clear instructions of implementation.
6.	Wenting, Lucy. Designing Interdisciplinary Education A Practical Handbook for University Teachers, Amsterdam University Press 2017	A must read for any interdisciplinary teacher. The publication contains not only descriptions of methods but also clear instructions how to create or modify interdisciplinary classes.

TM1

Energy awareness

Being aware of the importance of energy (for our life)

Meritxell Martell
Lluis Batet

Teachener

Funded by the
Erasmus+ Programme
of the European Union

Introduction

Many barriers to increase energy efficiency are related to people's behaviour rather than technological issues. Raising individuals' awareness and keeping people involved in energy management activities in their homes and in their workplace is vital to ensure energy efficient behaviours. This module aims to reflect on the need to address societal aspects (e.g. individual's motivations and behavioural changes, institutional practices, etc.) beyond technological ones when raising energy awareness and implementing policies and projects. It will trigger discussions on values, motivations and barriers related to energy savings in our daily routines. It will also draw attention to the vital **importance of social sciences and humanities (SSH)** for addressing the socio-technical challenges related to secure, clean and efficient use of energy.

In this module, the students will explore why and how SSH can help address energy issues and will reflect on how cooperation between technical and SSH disciplines could be enhanced. It is of utmost importance that technology students are aware of the social aspects in the implementation of energy policies or projects and that they understand the terminology and concepts so that they can frame questions more broadly when addressing social issues in this context.

In the debates on the future of energy policy, there is often a tendency to start with the type of technology rather than to think of the social and political aspects of policy implementation. This may result in controversial debates, as the **wider societal and political context** is not sufficiently addressed. For instance, different societal groups perceive a gas pipeline crossing a pristine environmental area in different ways. Some groups value the economic development it may bring whilst environmental groups perceive it as an unacceptable threat to the environment. Nowadays, developing energy policies which address the three core trilemma dimensions conceptualised by the World Energy Council - **energy security, energy equity and environmental sustainability** – demands recognition of the complex intertwined links between public and private actors, governments and regulators, economic and social factors, natural resources, environmental concerns and individual actions. As part of this complexity, social sciences can help to:

- Understand or acknowledge social and individual behavioural factors;
- Assist in framing priorities and questions for policy-making based on the diverse societal values and concerns;
- Form the basis for more informed decision making and communication strategies with the public;
- Open up spaces for robust policy debate.

Thus, firstly, social sciences describe human behaviour and social conditions and assess the consequences of changes to those behaviours and conditions due to policy implementation. Secondly, they try to understand how social and natural scientific knowledge is used as evidence in the policy process. Thirdly, social sciences and humanities help shape and configure policies.

The teaching module is composed of 2 successive sessions:

1

Session 1: Introduction to energy awareness
introduces the energy awareness and students are asked to reflect on their own behaviour regarding energy consumption.

90 minutes

2

Session 2: Workshop and role play
is based on the energy policy in Canada; students play a game with cards in teams of 4 up to 6, where they discuss different priorities regarding the adoption of sustainable energy policies and present their agreed (or not) policy in class. This approach will enable students to grasp the sense of the importance of SSH and the complexity of changing behaviours regarding energy use and consumption when making policy decisions on energy issues.

180 minutes

Session 1:

Introduction to energy awareness

a) Session objectives

This session is intended to give students a general knowledge of why energy awareness is important in order to understand the difficulties of changing consumption and production patterns and the complexities of energy policy-making. It starts with making students reflect on their own energy use, consumption and opportunities to increase energy efficiency in their home and study place. Afterwards, students reflect on the importance of social sciences as a supporting tool to make decisions on energy policies as well as the importance of raising public awareness of the benefits of adopting energy efficiency behaviours.

b) Session scope

Behaviour change

Energy user's behaviour is a key factor influencing the way they respond to energy efficiency policies and whether they choose (or not) to adopt energy efficient technologies and services. Therefore,

» *UNDERSTANDING HOW THE DESIGN OF POLICIES AND TECHNOLOGIES CAN AFFECT ENERGY USERS' BEHAVIOUR IS CRUCIAL FOR REALIZING ENERGY EFFICIENCY GOALS*

Behavioural models are key to understand what consumers do and why they do so. The insights of behavioural sciences point out that people are more inclined to take action on an issue when they think other people are doing better than they are. Thus, social pressure is powerful to change people's behaviour. Energy efficiency measures rely on people adjusting their energy consumption behaviour.

There are different types of instruments which can be used to influence behaviour – economic instruments, communicative instruments, infrastructural provisions or regulatory instruments. When formulating an intervention strategy to change behaviour, there is often a mixture of these instruments. In addition, there are motivating, enabling and reinforcing factors of behaviour. Motivation by itself is not enough; one has to be 'able' to perform the desired behaviour. Thus, motivating (knowledge, attitude, awareness, etc) and enabling factors (financial, organizational, technical, etc) can influence individuals to start the desired behaviour, but in order for it to be permanent, it requires reinforcement. Reinforcing factors are external to the individual and include feedback from peers, experts, authorities and customers.

Jeni Cross, Ph.D., is currently Associate Professor in the Department of Sociology. She earned a bachelor s degree from Colorado State University and received her Ph.D. in Sociology from the University of California at Davis.

Jeni's research interests include community attachment/sense of place, land use and conservation, sustainability, inter-agency collaboration, social networks, and social norms. [...] Her current projects include research on land conservation decision-making, energy conservation and sustainability in public schools, and inter-agency collaboration related to organizational transformation.

Source: https://www.libarts.colostate.edu/people/jecross/

Jeni Cross, who is a sociology professor at Colorado State University, talks about the three myths of behaviour change, which include:

1. MYTH: Education is enough to change behaviour.
TRUTH: You can change behaviour if you make the information tangible, tell people exactly what you want them to do and create a unique message for each audience;

2. MYTH: Changing attitudes changes behaviour.
TRUTH: Attitudes follow behaviour, they do not predict it. You can change behaviour by setting behavioural expectations and connect to people's values;

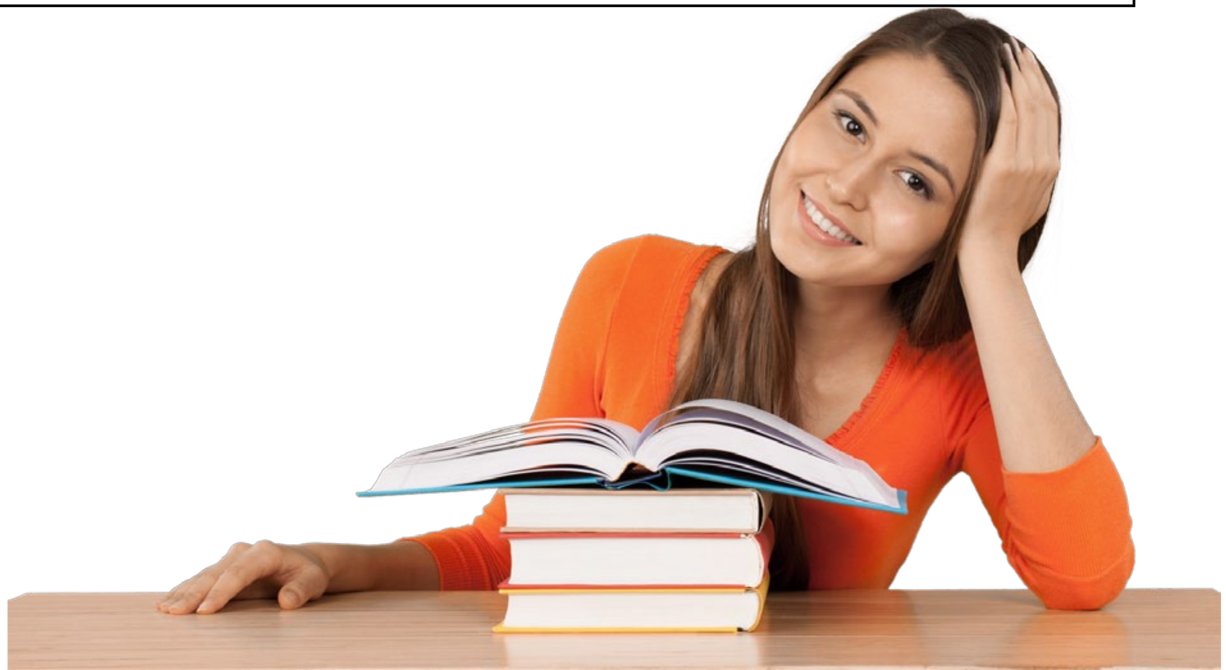
3. MYTH: People know what motivates them to take action.
TRUTH: Social norms influence our behaviour, other people doing it is most influential in changing behaviour

Energy studies need social science

Professor Benjamin Sovacool has examined 4,444 full-length articles published between 1999 and 2013 in three leading journals and has found that the field of energy studies lacks interdisciplinary focus and it infrequently uses social science methods and concepts. Under 20% of all energy research is currently performed by social scientists. He argues that a broader pool of expertise is needed to understand how human behaviour affects energy demand and the uptake of technologies.

c) Pre-reading

No.	Author and title	Description
1.	Laskey, Alex. How behavioural science can lower your energy bill https://www.youtube.com/watch?v=4cJ08wOqloc&t=6s	Introductory video from Alex Laskey as part of TEDTalk (2013) on behavioural science and how to lower energy costs.
2.	Cross, Jenni. Three Myths of Behaviour Change https://www.youtube.com/watch?v=l5d8GW6GdR0	Introductory video as part of TEDTalk (2013) discussing on changing behaviours and what we think we know but we do not know.
3.	Sovacool, K. Benjamin. Diversity: Energy studies need social science. “Nature” 2014, Vol. 511, Issue 7511, pp. 529-530. DOI: 10.1038/511529a	Nature article (2014) from a sociologist discussing that a broader pool of expertise is needed to understand how human behaviour affects energy demand.



d) Session activities

Activity 1:
Introductory presentation

Methods	Interactive lecture
Keynotes	None
Materials	**TM1-ST1-RM1-Energy awareness presentation (slides 1-16)** **TM1-ST1-RM2-Introductory videos**
Required accessories	Computer + projector
Time allocation	30 min
Learning outcomes	Basic knowledge of energy awareness

The purpose of this activity is to make students reflect on the difficulties of promoting a change in behaviour regarding energy production and consumption. The teacher can start by asking students why we should save energy, why they think this topic is important (e.g. climate change, money savings, for future generations, etc). Then the teacher can show the first 3:38 minutes of the TED talk of James Brew on the value of energy efficiency (TM1-ST1-RM2 – introductory videos) which provides more motivations for saving energy in a fun presentation or can show the whole video.

After showing the scope of the presentation, the teacher can start asking students the same questions which were used in the TED2013 video by Alex Laskey **"How behavioural science can lower your energy bill"** (TM1-ST1-RM2 – introductory videos):

- How many of you have checked your email today?
- How many of you are checking it right now?

- How many of you have checked your bank account today? Or last week?
- How many of you have checked your household energy bill last month? Last winter?

Then, the teacher asks students why we do not pay attention to our energy use, why it is important to save energy and how we can get people to start paying attention to the energy we are using and start wasting less of it (slide 5 on the role of behavioural sciences). The video explains the behavioural science experiment undertaken by some graduate students in California showing what drives a change in behaviour to lower the impact on energy consumption. The experiment showed that the message which had an impact on neighbours to reduce energy was not related to economic incentives (saving money), being good citizens or protecting the environment, but rather, whether the neighbours were using less energy.

» *SOCIAL PRESSURE IS A POWERFUL FORCE TO CHANGE OUR BEHAVIOUR.*

The lecturer briefly presents the main factors influencing consumer behaviour related to the patterns of electricity production and consumption (slide 6). The main tools that have been applied to improve energy efficiency or to reduce energy use have mostly been technological and economic. In energy economics, the rebound effect refers to the fact that new and more efficient technology can lead to less-than-expected savings or even greater energy consumption. Stanley Jevons maintained in 1865 in his book “The Coal Question” that efficiency renders energy more affordable and hence, it is wrong to assume that the economical use of fuel is equivalent to a diminished consumption. This is often referred to as the Jevon’s paradox. In some cases, where increased consumption more than cancels out any energy savings, this rebound effect is known as “backfire”.

Usually, when economic incentives are removed, behaviour reverts back to baseline conditions. However, behavioural approaches can help reduce energy use. A common belief is that turning devices off and back on again uses more energy than just leaving them on. In fact, it is more efficient to turn off lights if you are leaving a room for more than one second. However, providing information alone will rarely have lasting effects on behaviour. Issues such as trust in the person that communicates, a simple message, engagement of end-users, social pressure, etc., also play a role in motivating a change in behaviour.

» *SOCIAL SCIENCES ARE NEEDED TO UNDERSTAND HOW HUMAN BEHAVIOUR AFFECTS ENERGY DEMAND AND THIS WILL BE A KEY MESSAGE FOR STUDENTS TO CAPTURE AT THE END OF THIS SESSION.*

The three myths of behaviour change (TM1-ST1-RM2 – introductory videos) are presented and later on explained one by one (see slide 9 presentation TM1-ST1-RM1 and notes): i) education is enough to change behaviour; ii) trying to change attitudes and iii) people know what motivates them. An example the teacher can mention (slides 14-16 of the presentation) follows: it is more effective to leave a message in a hotel room stating that a great number of clients are reusing towels rather than stating that in order to protect the environment the hotel asks you to reuse towels. The teacher should answer the question at the beginning of the video about which campaign is more effective to reduce littering (A or B). B campaign is the most effective because it utilises social norms and it also uses modelling and it shows someone doing the behaviour that you are interested in. Campaign A shows the behaviour that you're not interested in having people do "everyone is littering". Not only can you be ineffective in your campaign, but you can create a social norms campaign that increases the behaviour they are trying to reduce. They use social norms in a way that is ineffective.

Activity 2:

Energy consumption patterns

Methods	Participatory lecture, exercise and discussions
Keynotes	None
Materials	**TM1-ST1-RM1-Energy awareness presentation (slides 17-20)**
Required accessories	Computer, projector, flip chart, markers of different colours and tips
Time allocation	40 min
Learning outcomes	Understanding the difficulties of changing energy consumption patterns

Every day we make decisions that have an impact on the environment and in the use of energy. According to Eurostat (2018), energy use in households accounts for about one-quarter of all the energy used in the EU[1](slide 17). Students are encouraged to reflect on the **consequences of certain energy consumption patterns**. For this, the teacher starts this activity by distributing empty sheets with the energy impact self-assessment matrix for each student. Students spend a few minutes to fill in the matrix which is intended to help them gain an appreciation for their own impact on energy use. Once the matrix is filled in, students have to discuss and compare results in

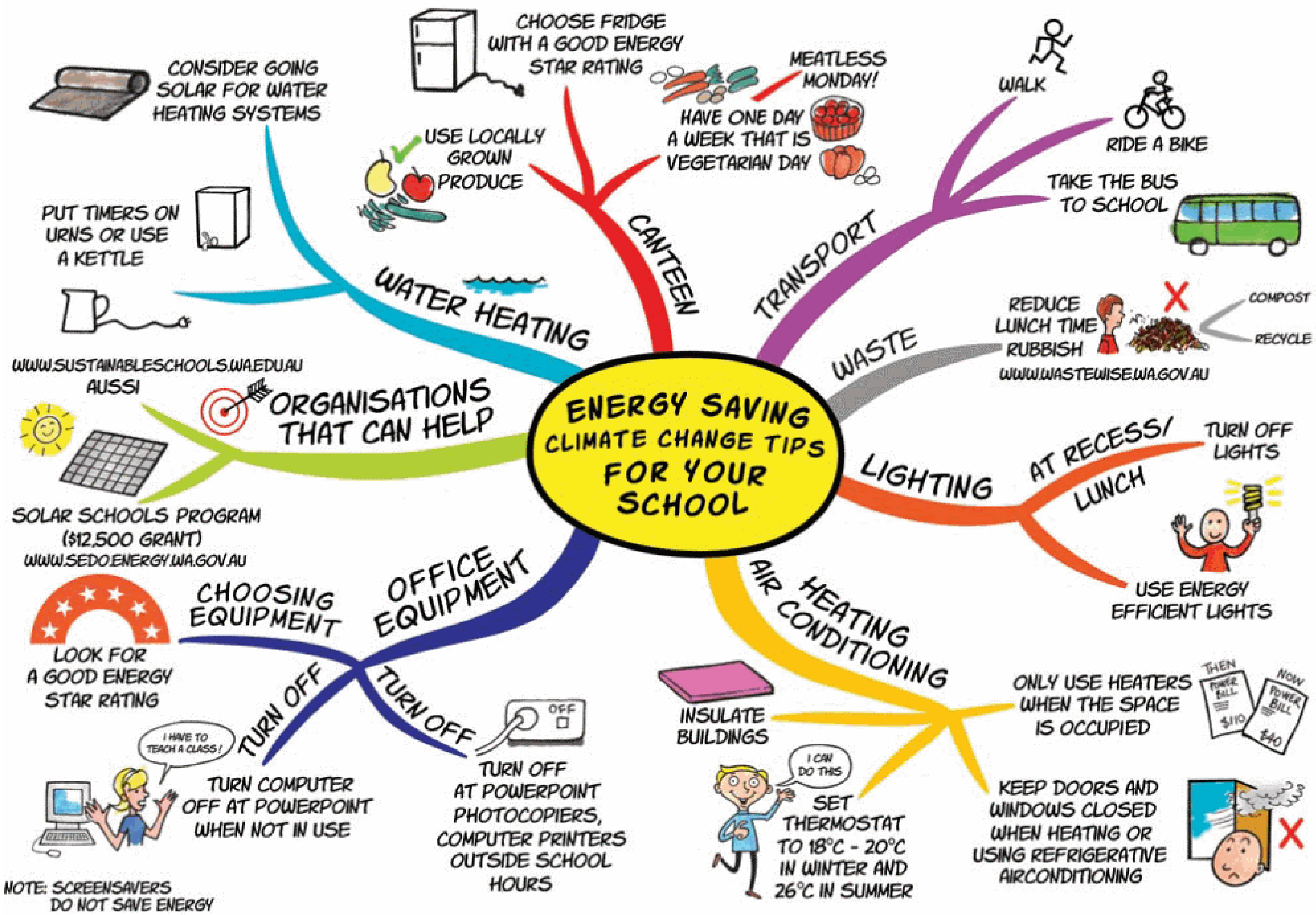
[1] https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Energy_statistics_-_an_overview#Final_energy_consumption

groups of 2 or 3 and there is a general discussion with the whole class to see if they have similar or different results and why.

The feedback to the energy impact self-assessment matrix can be summarized in a mind map or similar. The teacher asks for or chooses one or two volunteers to draw the mind map on the board, based on the ideas provided in a participatory debate with the rest of the class. An example of an energy saving mind map in a school is shown in Figure 1 below.

A question that can be asked is: ***what do you think could help your colleagues raise awareness of their energy consumption patterns?*** The answer could be having more knowledge of my energy consumption through smart meters, having more knowledge of the neighbours' energy consumption, financial incentives, etc.

Figure 1. Energy Saving Mind Map



Source: http://www.mindmapart.com/galleries/jane-genovese/

Activity 3:
Summary discussion

Methods	Presentation
Keynotes	None
Materials	**TM1-ST1-RM1-Energy awareness presentation (slides 21-26)** **TM1-ST1-RM3-energy impact self-assessment matrix**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Awareness of social sciences for decision-making

This last activity focuses on the role of social sciences to understand attitudes towards energy use, which has been mentioned already in the previous activities. For this, the study of Benjamin Sovacool analyzing studies articles (4,444 articles) in energy research over 15 years (from 1999 to 2013) is shown. It shows that there is a bias towards science, engineering and economics over social sciences and humanities and a lack of interdisciplinary collaboration. Behaviour and energy demand was investigated in less than 2.2% of papers. There are few social scientists in national and local energy bodies and thus, there is no input on policy-making into how to alter lifestyles and social norms, but research mainly focuses on technical issues. He claims that universities should develop courses focused on solving energy problems, granting agencies should prioritize and direct more money to behavioural work, and energy journals should broaden their scope.

» *It is important to recognize that the engineering-based approaches and the social-science approaches to certain problems differ:*

both approaches use different tools and ask different questions. For engineers, the collection of data and measurements which are constant over time and space is important, whereas social scientists rely on a number of qualitative methods (e.g. the collection of experiences, insights, cultural narratives, etc.) which may only be valid for certain times and places. Additionally, ethical issues play a much larger role in the social sciences. Both approaches are valid but the way they address problems is different. The teacher can ask students to try to formulate questions regarding energy use in commercial buildings from the point of view of the engineering-based approach and social science-based approach. See for example the table below comparing both types of questions:

Engineering based questions	Social science-based questions
• How much energy is used in a building (predicted or measured)? • Where is the energy being used? • How much energy can be saved? • What is the time period for technology adoption? • What are the market barriers? • What are the appropriate energy targets for new construction? • How do you add more functionality to the energy management system? • What are the carbon credits for improved energy efficiency?	• What services do owners and occupants value in commercial buildings? • How are design decisions made that ultimately affect the health, productivity and comfort of occupants? • Who determines changes in the building operation? • Who gains and who loses in any proposed change? E.g. how do manufacturers and the government department responsible for energy come to mutually satisfying "solutions"? • What are the possible unintended outcomes from a proposed change? • What information and incentives do building operators need to effectively operate their buildings? • How does society recognize the consequences of increased energy consumption?

Source: extracted from the paper from (Diamond, Moezzi 2002) "Becoming Allies: combining social science and technological perspectives to improve energy research and policy making"
https://aceee.org/files/proceedings/2002/data/papers/SS02_Panel4_Paper08.pdf

Using social sciences in the context of energy policy decisions may have pros and cons, as shown in slide 25.

PROS	CONS
Prevents wasting money	Slower
Empowers individuals and communities	Requires flexibility
Integrates human dimensions to improve energy policies	Economic resources spent on research
Facilitates more legitimate and robust policies	
Frames energy-saving programmes	

Slide 26 of the presentation summarises the two main points of this first session:

- Simple changes in people's behaviour can lead to significant energy savings, but such changes will only happen if the people are aware of the energy consumption that they have the power to control.
- Social sciences help to understand people's behaviour regarding energy use, which is key to make decisions which will affect them.

e) Additional resources

No.	Author and title	Description
1.	European Environment Agency. 2013. Achieving energy efficiency through behaviour change: what does it take? Technical report No 5/2013. EEA: European Environment Agency, Copenhagen. https://www.eea.europa.eu/publications/achieving-energy-efficiency-through-behaviour/file	This report addresses the interface between policymaking and human behaviour as a means to achieve sustained reductions in energy consumption. It argues that there is potential for energy savings due to measures targeting behaviour. The report focuses on energy efficiency measures and behaviour changes, structural factors (such as the impact of liberalisation and the energy mix and energy tariff structures) and the rebound effect.
2.	OECD. 2017. Tackling Environmental Programs with the help of Behavioural Insights. Policy Highlights. Paris. https://www.oecd.org/environment/tools-evaluation/Policy-Highlights-Behavioural-Insights.pdf	This report reviews developments in the application of behavioural insights to encourage more sustainable consumption, investment and compliance decisions by individuals and firms. It portrays how behavioural sciences have been integrated into the policy-making process. The report covers a variety of policy areas: energy, water and food consumption, transport and car choice, etc.
3.	Dahlbom, Bo, Heather Greer, Cees Egmond, Ruud Jonkers (eds.) 2009. Changing energy behaviour. Guidelines for Behavioural Change Programmes. Instituto para la Diversificación y Ahorro de la Energía (IDAE), Madrid. Supported by Intelligent Energy Europe. https://www.idae.es/uploads/documentos/documentos_10457_BEHAVE_changing_energy_behaviour_09_c5724555.pdf	This publication starts with a brief overview of the importance of behavioural change for a sustainable energy future. It then discusses the theory and planning method for behavioural change programmes and follows with an overview of lessons learnt in 41 cases in Europe over the last years.

Session 2:
Workshop and role play

a) Session objectives

This session is basically oriented to conduct a role play simulation exercise based on a specific scenario around a challenging energy policy. The teacher proposes to play a game ("PlayDecide") in groups of four to eight students in order to improve awareness about energy issues, spread the knowledge about new energy technologies and launch a debate about the effective potential of these technologies, facing pros and cons. Participants are assigned different roles based on the cards in the PlayDecide game. After that, one of the groups or several, depending on the time available, will be randomly chosen to present the policy proposed in front of different members of the audience (e.g. neighbouring communities, political parties, businesses, NGOs, etc.) played by the rest of students. In case the group is small or there is not enough time, the role play can be skipped and the teacher can lead a debate in order to discuss how the groups discussed, what they felt was important and why, whether they could reach an agreement, etc.

b) Session scope

This session is based on the PlayDecide game: a card game for simple, respectful, structured and fact-based group discussion. It enables students to explore a topic in depth in an informal and informative way. Players get familiar with a question, see it from different perspectives and form or clarify their own opinion. The question is whether the participants can reach a positive consensus on that complex issue. The ideal number of players is 4 to 8, with the possibility of splitting large groups into several smaller ones.

Canada – case study

As the population of the world increases and energy-consuming activities in the developed countries expand, the need for energy also increases as well as the emissions of greenhouse gases. Fossil fuels like coal, oil and natural gas, continue to be a dominant energy source but they are a finite resource and supplies will run out. Attempts to reduce greenhouse gas emissions continue to be made but the latest scientific evidence suggests that if little or no action is taken to reduce global emissions, by the end of this century, global warming is likely to exceed the 2 °C target. These energy challenges require governments to invest in renewable energy resources which are clean, safe and inexhaustible. However, how would the infrastructure of a country have to be changed to accommodate renewable energy sources? Does the technology exist to make this type of production viable? Are government policies the right way to invest in renewable energy production? These are the questions to be explored in the PlayDecide game taking Canada as a case study.

The following policy positions for our PlayDecide game can be these ones or groups can define new policy positions:

Policy position 1: the focus should be placed on reducing emissions. We can reduce emissions by changing personal lifestyles, developing incentive programmes, developing stricter regulations and enforcement, and changes in infrastructure including transportation, energy production, energy delivery and industrial usage.

Policy position 2: investment in new technologies, engineering, architecture, and energy production are the most important. Current renewable energy technology falls short of our needs, and investment is needed to find better energy solutions. We need to maintain the current system, using existing resources until these new technologies become available.

Policy position 3: there are promising renewable energy sources that already exist that could work with the proper investment. Like all other technologies, renewable energy has to be economically competitive. Constantly investing in new forms of technology is a waste of time and resources. It makes more sense economically to invest everything in one or two of the most successful types of renewable energy and maximize efficiency and profit.

Policy position 4: the harm we have caused to our planet is irreversible, and our planet has surpassed the tipping point. Many climate models predict that climate change will continue to occur, regardless of how much we reduce emissions. The time for action was decades ago, not today. Our focus now needs to be on how we can adapt to changes in our climate.

c) Pre-reading

No.	Author and title	Description
1.	Craciun, Dana. Role-playing as a creative method in science education. „Journal of Science and Arts" 2010, Vol. 10, Issue 1. http://www.icstm.ro/DOCS/josa/josa_2010_1/c.11_role_playing_as_a_creative_method_in_science_education.pdf	PlayDecide game focused on the need to produce more energy in Canada and the different possible policy positions to face this challenge.

No.	Author and title	Description
2.	Skelton, John et al. 1999. Role play as a teaching methodology. Barmingham: University of Birmingham. https://ler.letras.up.pt/uploads/ficheiros/6089.pdf	To learn more about energy facts in Canada, the teacher and students could get information on energy challenges in Canada by looking at this webpage of Natural Resources Canada. However, assumptions can also be made regarding the energy policies in Canada for the activities described in this session.

d) Session activities

Activity 1:

Presentation of scenario based on PlayDecide game

Methods	Presentation
Keynotes	The teacher should be familiar with the steps and rules of the PlayDecide game before presenting it to the students.
Materials	**TM1-ST2-RM1-Instructions for the teacher** **TM1-ST2-RM2-PlayDecide instructions** **TM1-ST2-RM3-PlayDecide game energy Canada** **TM1-ST2-RM4-Canada energy factsheet**

Required accessories	1 placemat in A3 format per player 1 pack of story cards 1 pack of issue cards (on blue paper or margins) 1 pack of info cards (on green paper or margins) Yellow cards (on yellow paper or margins) White cards (on white paper) 1 pack of challenge cards (on orange paper or margins) 4 forms of "Theme of Clusters of cards" 1 voting form "policy regulations" Instructions and cards of the PlayDecide game
Time allocation	15 min
Learning outcomes	Students get information about the organization of the PlayDecide game and the role play.

The teacher presents the organization of the exercise based on the rules of the PlayDecide game. The teacher explains the aims of the game and the guidelines and gradually distributes the cards to each of the groups during the duration of the exercise.

Students divide themselves into groups of 4 up to 8 people. Each group has to choose a rapporteur. The starting point for this exercise is to debate within the groups *"Which is the most favourable policy position in order to change our attitudes and habits with regards to energy production and consumption and ultimately, reducing greenhouse gas emissions?".*

Activity 2:
Discussion on energy and sustainability

Methods	Discussion in working groups
Keynotes	None
Materials	**TM1-ST2-RM2-PlayDecide instructions** **TM1-ST2-RM3-PlayDecide game energy Canada** **TM1-ST2-RM4-Canada energy factsheet**
Required accessories	placemats, instructions and cards of the PlayDecide game
Time allocation	105 min
Learning outcomes	Students gather and share information based on the cards of the Playdecide game, then discuss and finally formulate a shared group response.

This activity uses one of the kits on “Energy and sustainability” of the PlayDecide game (http://www.playdecide.eu) to generate discussion among students on different policy positions regarding energy lifestyles and energy awareness. The kit is entitled Energy in the North: a Canadian translation of “Energy & Sustainability”. The teacher has to pace the game, checking the timing and providing new instructions and cards when needed, for each phase. The teacher also goes around the groups to make sure that the students correctly understand the task.

All players have a placemat in front of them. The facilitator provides the cards (one story card) to the other members of the group and chooses also one for him/herself. The other cards are also distributed following the rules of the PlayDecide game. White cards can be used at any time to add information and issues needed. Yellow cards are used to flag that there are guidelines which are being broken or if a member does not understand what is going on. Discussion is open to try to get a consensus on a policy position that reflects the group's view on how best to change personal lifestyles to reduce emissions considering the different positions. If the discussion is difficult, challenge cards which are face down can be used to take action. Cards are put on the placemat to sustain arguments. Players in the groups are requested to vote among four different solutions offered in the game's kit or new solutions they have come up with.

Activity 3:
Mock Policy debate, role play

Methods	Role playing game
Keynotes	None
Materials	**TM1-ST2-RM5-Handout role play session**
Required accessories	None
Time allocation	30 min
Learning outcomes	Students can empathize with socio-scientific issues and communicate those.

This role-playing game (as explained in TM1-ST2-M1-handout) is based on the idea that the national government has launched a public consultation process as an important part of the policy-making process. In coordination with national efforts to reduce greenhouse gas emissions, community leaders are looking into feasible options to promote renewable energy and they want to learn about local stakeholders' perspectives on the issue. A town meeting hall is one way through which the national government can consult and involve different stakeholder groups in energy policy making: stakeholder groups are invited to share their positions on the issue, voice concerns, ask questions and listen to the others.

The aim of this role-playing game is to engage the public and interested groups in the development of the energy policy, by listening to their views and opinions and use these to inform decisions. Members of the government present their policy position to local communities through meetings organised at local councils all over the country. Thus, students participate in a mock town hall meeting where members of the government leaders are seeking input from local communities on how to reduce greenhouse gas emissions via different strategies such as technology, changing behaviours, laws and regulations, etc. Students have to discuss what is their recommendation and how to raise awareness on the energy problem and their solution proposed.

Depending on the results of the discussion in groups, the teacher can propose one group or the rapporteurs of the different groups to gather together and play the role of the national government presenting their policy position in front of the audience. The audience (the rest of the students) represent different target groups, for instance, neighbouring associations, opposition political parties, environmental groups, companies promoting a different type of renewable energy, etc. The newly formed group of national government representatives will take some minutes to decide together how they will present their policy position, which does not need to be the one they defended during the PlayDecide game. The other group (i.e. audience) will take some time to prepare the questions they will pose to the government representatives.

The teacher organises the desk and chairs in a way that one group is at the front of the class to present if they agreed on a specific policy position and its justification. The teacher will now act as a facilitator of the town hall meeting. He/she will welcome the participants at the meeting, will introduce the members of the group who will present and explain the purpose of the meeting.

The presentation, of approximately 15 minutes, will be followed by questions from the other players. The teacher will encourage students to be creative and have fun playing their new roles! The main goal of the teacher will be to try to work out a compromise to satisfy all the groups to implement a certain energy policy or to highlight the different positions.

Activity 4:
Summary discussion / debrief

Methods	Open discussion
Keynotes	None
Materials	**None**
Required accessories	None
Time allocation	30 min
Learning outcomes	Students reflect on the different positions and perspectives of stakeholders before taking decisions on energy policies. Increase awareness of the role of social sciences and humanities as an input to policy-making.

Some discussion and final thoughts will conclude the session. The discussion could include the following questions:

- Do you think there are stakeholders' perspectives missing during the role play?
- Did you connect or identify with any of the stakeholder perspectives? Which ones?
- If you were a researcher on social science, how do you think you could help community leaders to make better decisions regarding energy policy?

As a final assignment, students have to write down the main arguments for and against the policy position proposed by the group and reasons why they chose a certain approach.

e) Additional resources

No.	Author and title	Description
1.	International Energy Agency. 2015. Energy Policies of IEA Countries: Canada 2015 Review. Paris. https://webstore.iea.org/energy-policies-of-iea-countries-canada-2015-review	An individual country report reviewing energy policies in Canada: part 1 on policy analysis (general, climate change and energy efficiency); part 2 by sector (natural gas, oil, coal, electricity, renewable energy and nuclear) and part 3 on energy technology research, development and demonstration.
2.	Demain (2015) French film, translated as "Tomorrow". https://www.youtube.com/watch?time_continue=3&v=Bk2LnbrXx_I	A useful resource for this module is the film "Tomorrow" ("Demain" in French from Cyril Dion and Mélanie Laurent https://www.demain-lefilm.com). It shows solutions to replace fossil fuels and the way to the transition to 100% renewables in some countries and cities (Iceland, Copenhagen, Reunion island, etc.), the need to reflect on our consumption and mobility patterns and increase energy efficiency, etc. The movie can be bought through Amazon.

Assessment methods and final assignment

Activity 3 in Session 2 includes the final assignment in which the students are asked to write down the main arguments for and against the policy position proposed by the group and reasons why they chose a certain approach. Issues to be taken into account in this assignment include:

- Role that social sciences and humanities can have in order to help shape and configure the chosen policy;
- Main aspects of an energy awareness campaign.

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the module.

Glossary

Behavioural sciences	experimental approach within social sciences which consists of studying human actions in order to understand how people behave and what drives them to do certain actions.
Framing (social sciences)	comprises a set of concepts and theoretical perspectives on how individuals, groups, and societies, organize, perceive, and communicate about different aspects of reality. It involves social construction of social phenomena by mass media sources, political or social movements, political leaders or other actors and organisations.
Humanistic engineering	integration of the humanities and social science disciplines with engineering.
PlayDecide	a card game for simple, respectful, structured and fact-based group discussion. It enables students to explore a topic in-depth in an informal and informative way. Further information at playdecide.eu.
Socio-technical	refers to an approach which has at its core the idea that ‘social’ and ‘technical’ aspects are intertwined and should be treated as interdependent parts of a complex system.

Attachment: Syllabus

1. Name of the Teaching Module

Energy awareness. Being aware of the importance of energy (for our life).

2. Brief description of the subject matter

This module aims to reflect on the need to address societal aspects (e.g. individual's motivations and behavioural changes, institutional practices), beyond technological ones, when raising energy awareness and implementing policies and projects. It will trigger discussions on values, motivations and barriers related to energy savings in our daily routines. It will also draw attention to the vital importance of SSH for addressing the socio-technical challenges related to secure, clean and efficient use of energy. The students will explore why and how SSH can help to address energy issues and will reflect on how cooperation between technical and SSH disciplines could be enhanced.

3. Complete SSH problems description

When trying to implement energy policies or projects, the behavioural and social aspects are highly relevant. It is important to look beyond the technology proposed and into the wider socio-technical challenges and opportunities associated with motivating behavior change towards energy efficiency. Taking societal issues into account at an early stage of a project and in the policy-making process may facilitate the implementation of certain technologies or policies. It is of utmost importance that technology students are aware of the social aspects in the implementation of energy policies or projects and that they understand the terminology and concepts, so that they can formulate the right questions when addressing social issues in this context.

4. Prerequisites and context

This module is addressed to students in Engineering Faculties which are following an Energy related Master Programme. Students do not need to have a strong technical background on engineering, but knowledge of technical matters will help. Students must have taken or be taking part in courses where energy projects are developed.
The module on Ethics and Philosophy of Energy Development is complementary to this one, by providing the theoretical and historical

background. The module on Ethics and Philosophy is more focused on 'why' technologies can be a source of social impact but also of cultural identity, why there is a conflict between the industrial past and the current environmental values and why ethical questions and responsibility should be taken into account when designing energy strategies.
The present module takes a more practical approach focusing on how specific energy policies should address the complex interplay between what are typically seen as distinct "technical" and "social" dimensions and reflect on the contribution by social sciences to energy policies. For this, it is important to raise the students' awareness on the implications of current energy patterns of consumption.

5. Learning outcomes

a. Knowledge

- Students will have knowledge about a series of social aspects deserving consideration as related to energy projects/policies.
- Students will understand the importance of energy awareness in the implementation of certain energy policies in order to change behaviour.

b. Skills

- Students will be able to analyze a specific energy policy from the social and socio-technical perspective.
- Students will understand the complex interplay between technology-society-culture-environment and economy.

c. Social competencies

- Sustainability and social commitment.
- Team working.
- Effective oral and written communication.

6. Form of classes

- Lecture, workshop, group work, role play, discussion.
- Two sessions (2x45 min and 4x45 min) for up to 24 students.
- At least 70% direct student participation.

7. Teaching methods

- Concept problem presentation (powerpoint) with brainstorming, discussion and mind map.
- PlayDecide as fact-based group discussion around a specific case.
- Role play and debate.

8. Detailed classes plan

- Session 1. Introduction to energy awareness (2x45min)
  i. Introductory presentation
  ii. Energy consumption patterns (including an activity to fill in an impact self-assessment matrix and develop a joint mind map)
  iii. Summary discussion, highlighting the importance of social sciences in policy-making on energy.

  MATERIALS: presentation, matrix on energy impact self-assessment, videos.

- Session 2. Workshop and role play (4x45min)
  i. Presentation of the scenario based on the Playdecide game on energy and sustainability in Canada.
  ii. Discussion on energy and sustainability in groups.
  iii. Role play simulating a town hall meeting on defending the agreed energy policy and raising energy awareness.
  iv. Summary discussion

  MATERIALS: PlayDecide game instructions, cards, placemat.

9. TM assessment methods & criteria

A short assignment will be the method of assessment for this module in which the students are asked to write down the main arguments for and against the policy position proposed by the group and reasons why they chose a certain approach. Issues to be taken into account in this assignment include:

- Role of social sciences and humanities can help to shape and configure the chosen policy;
- Main aspects of an energy awareness campaign.

10. Literature and other materials

1. Energy and behaviour change

1.1. EEA Technical report. Achieving energy efficiency through behaviour change: what does it take? “European Environment Agency” 2013, No 5.

1.2. Dahlbom, Bo, Heather Greer, Cees Egmond, Ruud Jonkers (eds.). 2009. Changing energy behaviour. Guidelines for Behavioural Change Programmes. Instituto para la Diversificación y Ahorro de la Energía (IDAE), Madrid. Supported by Intelligent Energy Europe.

1.3. OECD Policy highlights. 2017. Tackling Environmental Programs with the help of Behavioural Insights. Policy Highlights. Paris.

2. Social sciences and humanities in energy

2.1. FET Advisory Group. 2016. The need to integrate the Social Sciences and Humanities within Science and Engineering in Horizon 2020 and beyond. FET (Future Emerging Technologies) Advisory Group. https://ec.europa.eu/digital-single-market/en/news/report-need-integrate-social-sciences-and-humanities-science-and-engineering-horizon-2020

2.2. Fri, W. Robert et al. 2011. Beyond Technology. Strengthening Energy Policy through Social Science. A report of the American Academy of Arts & Sciences. https://www.amacad.org/sites/default/files/publication/downloads/alternativeEnergy.pdf

2.3. Mourik, Ruth et al. 2017. Energy efficiency and using less – a social sciences and humanities annotated bibliography. Cambridge: SHAPE ENERGY. https://shapeenergy.eu/wp-content/uploads/2017/06/SHAPE-ENERGY-Annotated-Bibliography_ENERGY-EFFICIENCY-AND-USING-LESS.pdf

2.4. Ryan, E. Sarah, Chris Hebdon, Joanna Dafoe. Energy research and the contributions of the social sciences: a contemporary examination. “Energy Research & Social Science” 2014, Vol. 3, pp. 186-197. DOI: 10.1016/j.erss.2014.07.012

2.5. Sovacool, K. Benjamin. What are we doing here? Analysing fifteen years of energy scholarship and proposing a social science research agenda. “Energy Research & Social Science” 2014, Vol. 1, pp. 1-29. DOI: 10.1016/j.erss.2014.02.003

2.6. Spreng, Daniel. Transdisciplinary energy research – Reflecting the context. “Energy Research & Social Science” 2014, Vol. 1, pp. 65-73. DOI: 10.1016/j.erss.2014.02.005

2.7. Steg, Linda, Perlaviciute Goda, Ellen van der Werff. Understanding the human dimensions of a sustainable energy transition. “Frontiers in psychology” 2015, Vol. 6. DOI: 10.3389/fpsyg.2015.00805

TM2

Philosophy and Ethics of Energy Development

What are the most general questions concerning our attitudes to energy technologies?

Martin Durdovic
Jan Mlynar

Teachener

Funded by the Erasmus+ Programme of the European Union

Introduction

Energy production and energy facilities and projects are based on scientific knowledge and they require employment of various kinds of technologies. This links energy development with a more general view of natural sciences and technologies and their function in contemporary advanced societies. The impact of technologies on everyday lives of individuals, groups and communities has been growing unprecedentedly in recent decades. It does not matter whether we like it or not, whether we are techno-enthusiasts or technophobes - sophisticated technologies permeate our daily activities and businesses. We depend on them vitally in areas of communication, information management, transportation, housing, factory production or medical care, to name at least the most obvious ones. In this regard, energy technologies represent a piece of a more complex web of infrastructures securing smooth operation of our societies. However, energy production is the crucial piece, because continuous energy supply is a precondition for the majority of other activities or processes to take place.

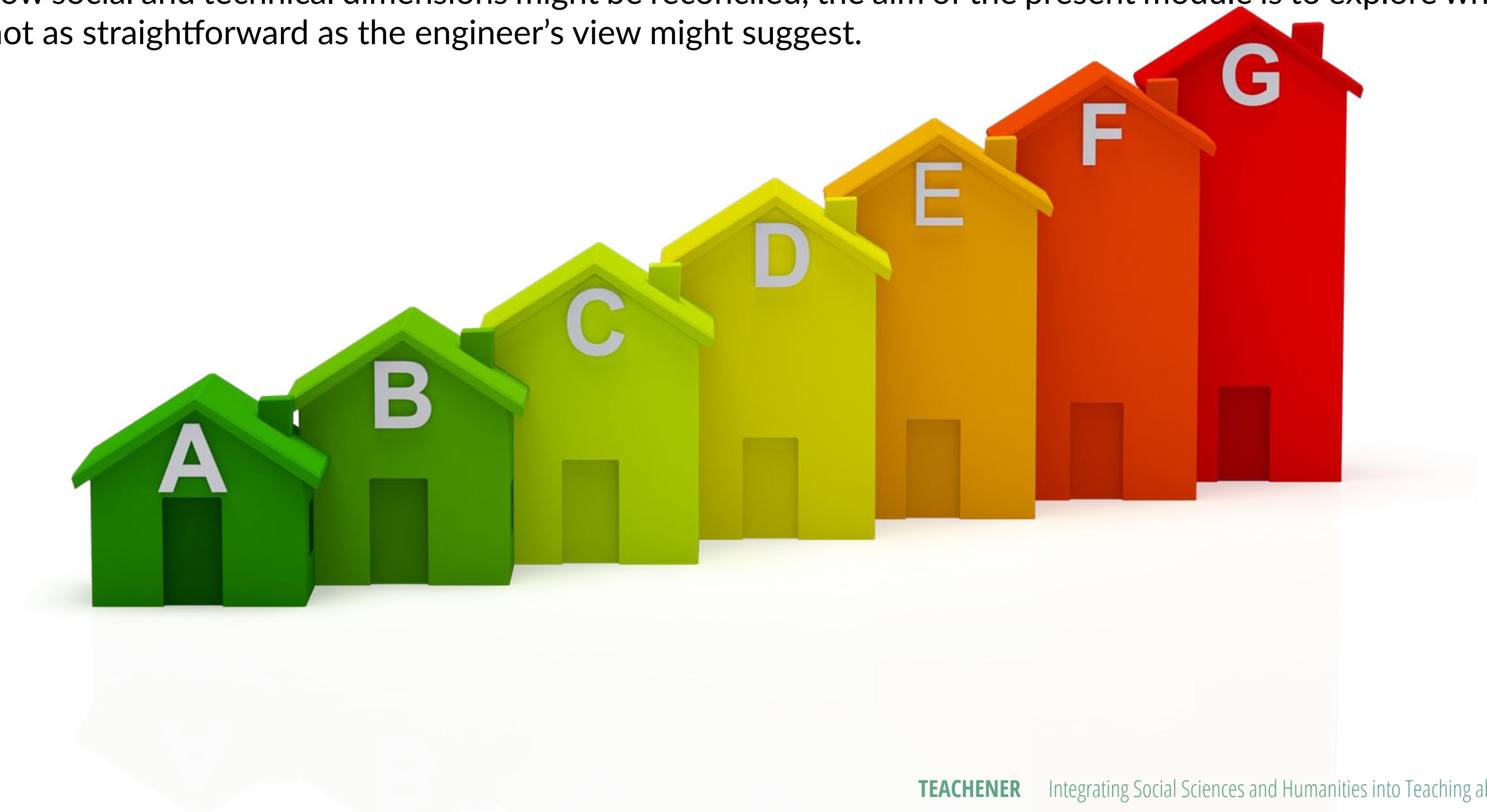
Sociological analysis of the relationship between science and technology on one side and society on the other has been intensifying steadily since the 1980'. One of the leading books of that time was the Risk Society from U. Beck (1992), which warned that even though technologies paved the way to increased standards of living, they also created unusual problems not intended by their introduction: air pollution, human health harms, weapons of mass destruction, nuclear waste and others. New technologies had to be invented in response to undesirable consequences caused by previous technologies. Importance of these issues emerging from interactions between technologies and societies gave rise to a new field of interdisciplinary research called “science and technology studies”.

Research organized under this umbrella covers a wide range of topics today, such as working of science as social institution, legitimacy of the decision-making about introduction of technologies, impacts of technologies on social relations and societies in total, exploration of consequences and risks opened up by emerging technological innovations (Felt et al. 2017).

The present module touches some of the issues falling into this wide and complex area. Compared to all remaining modules in the EduKit, it is the module, which is most general and abstract. It recognizes that technologies intervene in forms of social relations and interactions and can generate far-reaching social or societal changes. However, in the course of the three sessions, this general focus will narrow down only to energy technologies and projects. Within this topic, the teacher can mention that societal challenges sometimes go hand in hand with technological challenges: e.g., regulation of distributed power generation, power accumulation, limits of power transmission, waste burden (photovoltaics, batteries) etc.

The main aim of the sessions is to teach students that thinking only in terms of feasibility of technical innovations may prove misleading. Instead of waiting for various and possibly undesirable, harmful or unjust consequences of technological innovations, we should rather follow the principle of precaution, explore and map social impacts at the initial stage. Very often social impacts turn out to be interconnected with concerns about safety and possible risks. Nevertheless, to go beyond the standpoint of technical acceptability requires more than addressing these interconnections. It requires taking into account social acceptability in the population affected by introduction of the given energy technology. A possible example in this respect is the well-known copper plate model of the European power grid, which is presently in conflict with low social acceptability of investments into new high-voltage transmission lines (Papaefthymiou 2016).

Such considerations point to more general philosophical and ethical questions: What cultural and human values we subscribe to, when we opt for this or that energy solution? Is this solution in accordance with the values that we as individuals or (inter)national communities derive from our common past? Does it comply with the values that we want to invest in our future and bequeath to coming generations? What benefits justify possible negative effects? Which drawbacks, uncertainties or risks are unjustifiable? These are only a few examples of very general questions that energy projects sometimes induce. Whereas the module dedicated to energy awareness focuses in a rather practical way on how social and technical dimensions might be reconciled, the aim of the present module is to explore why the relationship between both is not as straightforward as the engineer's view might suggest.



The teaching module is composed of 3 successive sessions:

The module consists of three interlinked sessions. To explore thoroughly the topic of the module, it is advisable that all three sessions should follow one after another connectedly or in three single days. However, each session is optional and it is possible to select only one separate session without going through the others. Sessions combine lectures and presentation of materials with interactive elements, group work and with an Oxford-style debate.

1

Session 1: Natural sciences, technologies and modern societies
explains the role of science and technology in modern societies.

90 minutes

2

Session 2: The conflict between industrial past and environmental values
focuses on efforts that societies in Europe and worldwide currently put into the projects of energy transitions.

180 minutes

3

Session 3: Energy and ethics
familiarizes technical students with the ethical or moral dimension of energy issues.

90 minutes

Session 1:

Natural sciences, technologies and modern societies

a) Session objectives

Students will learn to perceive science and technologies as generators of social change and will improve their competence to identify social impacts of technologies on citizens as their users.
It is strongly advisable to familiarize yourself with this section before approaching the conduct of classes .

b) Session scope

Methodology of sciences grounded on empirical investigation of nature is a rather modern invention. In the last four centuries or so in Euromerican region, it has been evolving jointly with processes of political democratization, economic industrialization and social urbanization. In this context of the modern age, the traditional approach to science and technology was established during the industrial revolution in the 19th century. It glorified the triumphs of natural sciences and viewed the figure of a scientist as rather detached from the ordinary social live, as working in seclusion of laboratories and campuses (Callon, Lascoumes Barthe 2009). The ideal was non-partisan, objective science deriving its true and useful knowledge from methodically guided investigation of nature.

This approach defined also the function of scientific expertise. For modern thinkers, the development of sciences embodied the victory of enlightened reason over the prejudices. They took it for granted that technical applications of sciences would contribute to the welfare of the society. This harmonic picture of the relationship between science and society is still largely entrenched in today's scientific ethos. It helps to legitimize science in the eyes of the public. The task of scientists is to produce expert reports and recommendations, but it is the mission of politicians to take up these outcomes and decide, whether and how the innovative knowledge will translate into practical applications. In the modern age, this division of labor suited well to the widespread adoption of representative democracy with its mechanisms for delegating decision-making powers to people, who succeeded in elections.

We can call the traditional approach to the decision-making about technology technocratic. It certainly has its merits and has proved efficient in a number of ways. However, it cuts scientists off their responsibility for the misuse and unintended consequences of science and it maneuvers citizens and the public into the role of passive recipients of alleged benefits of science and technology. Once the politicians have decided about its introduction in practice, they leave the fate of any technological achievement to the loose operation of economic forces. Within the range of law, new technologies are embraced in manufacturing, services, households, infrastructures, life styles etc.

» *Yet, how to proceed if it turns out that the given technology does not work completely the way it was supposed to? What to do, when it has some side effects or when it affects social relations in an undesirable manner? What, if scientists have not checked everything in their reports? Who is then responsible and who should set the matters right? Among many examples known from the modern history we can name the abuse of nuclear energy, the endless discussion on vaccination, animal testing, the ambiguous potential of genetic modifications, or the recent fear of nanotechnologies and of robotics.*

It is hard to avoid situations like these completely. Nevertheless, it is reasonable to try to make them less probable. Energy facilities and projects may have extensive social impacts, which is difficult to predict and cope with in a strictly technical manner. In recent decades an alternative to the technocratic approach was developed, which is called participative decision-making and is intended as complement to the procedures of representative democracy. Session 1 helps students to grasp the logic behind the emergence of this alternative from a broader theoretical and historical point of view.

Other modules, especial TM3 – Energy and the public, familiarize students with an array of practices for participative decision-making.

c) Pre-reading

No.	Author and title	Description
1.	Callon, Michel, Pierre Lascoumes, Yannick Barthe. 2009. Acting in an uncertain world. Cambridge – London: The MIT Press, pp. 37–70.	Chapter 2 of the book explains the relationship between the science and society in the modern age.
2.	Law, John. 2017. STS as Method. In: Felt, Ulrike et al. (eds.). The Handbook of Science and Technology Studies. Cambridge – London: The MIT Press, pp. 1–27.	This text familiarizes the reader with the “science and technology studies” (STS).

d) Session activities

Activity 1:
Science and technology from the sociological viewpoint

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST1-RM1-introductory video**
Required accessories	Computer with internet access, projector, speakers
Time allocation	15 min
Learning outcomes	Understanding of the approach to science and technology within SSH

The session starts with showing that it is possible to study science and technology from the sociological viewpoint and that there is in fact an established research stream doing just this: “science and technology studies”. To make the presentation of this information easier for the teacher, who need not be more familiar with this research stream, and efficient for students, the experts in the video projection explain, what science and technology studies are about. The video is played with a view to opening up the topic of the session. After the video projection, the teacher initiates a short discussion by posing questions such as: Have you ever heard about science and technology studies before? If yes, in what context or situation? What do you think, in what way could such studies be useful to technical experts? Would you have any critical remarks as an expert engineer?

Activity 2:
Relationship between science and society

Methods	Lecture
Keynotes	None
Materials	**TM2-ST1-AM1-PP lecture**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the relationship between natural sciences and modern societies

In this lecture, the teacher firstly focuses on the role of natural sciences and technologies in modern societies. It is a rather general topic referring to the complex historical development of Euromerican societies in the modern era. The PP presentation, which the teacher uses as support, outlines the general message of the lecture.

However, to avoid the risk of getting lost in this tricky topic, the teacher should go beyond the PP presentation, when preparing for the class. The study of additional specialized literature will help to find proper words and mindset for depicting the story - for it is indeed possible to view the outlined historical development as a kind of story. The story about sciences and technologies changing the world we live in and reshaping social relations. In the second step of his or her explanation, the teacher should underscore the importance of these social impacts. The teacher is invited to give a few examples based on knowledge from the engineering education, e.g., the emergence of the internet, leading to the 'world wide web', which today resulted – among others – in cryptocurrencies as well as in the internet of things.

The first two steps of the lecture clarify a broader background, against which the concept of traditional technocratic approach to the decision-making arises. To introduce this concept is the main result of the lecture. Students should be able to understand in general, what this approach means and the teacher should give them notice about its possible drawbacks. At the end of the guided lecture, the teacher can stimulate students by posing rhetoric questions such as these: Where do you see strengths and weaknesses of this approach? How could alternative approaches to the decision-making about technologies look like?

Activity 3: Discussion

Methods	Presentation
Keynotes	None
Materials	**TM2-ST1-RM2-case study video**
Required accessories	Computers with internet access, projector, speakers
Time allocation	15 min
Learning outcomes	Understanding of the difference between technocratic and participative decision-making

The presentation of the case study serves as means for engaging students in thinking about participative approach, which may be viewed as an alternative or complement to the technocratic one. The teacher should utilize the resources to learn basic facts about the subject of the case study and pass this information to students at the beginning of the case study presentation. The short video projection about cities in transition illustrates, how the relationship between technologies and citizens as their users may change, if we switch to the participative approach. In case citizens deliberatively decide to incorporate technologies into their community life and identify with them, these technologies can transform into the values changing the community culture, life styles and patterns of behavior.

At the same time, the teacher may mention the fact, that the participative approach can be counteractive in some cases, at least from a purely technological point of view. For example, the participative approach encourages the construction of passive buildings, which are not only more expensive in investment, but also offer less comfort compared to a standard house. In order to increase the thermal efficiency, for instance, the inhabitants of passive buildings depend on centralized ventilation system (Schieweck 2018).

The teacher checks, whether students understand the difference between technocratic and participative approach: Do they have their own experience with participative projects? Maybe more local ones, connected to the cities or municipalities, where they live? Does any project they know incorporate energy technologies? In conclusion, the teacher sums up the main features of the participative approach.

Activity 4:
Comparison of approaches to the decision-making

Methods	Group work
Keynotes	None
Materials	**TM2-ST1-AM2-group work** **TM2-ST1-AM3-handout**
Required accessories	Computers operated by students
Time allocation	15 min
Learning outcomes	Improved competence to perceive and identify social impacts of technologies, improved competence to perceive citizens as users of technologies

The activity will shift the workload from the teacher to students. The aim of this interactive exercise is to let students themselves explore and evaluate both approaches of decision-making. The teacher asks students to divide themselves into two groups. One group will be dealing with the technocratic, the other with the participative approach. Each group will use PP document template to indicate the given approach:

- its advantages and disadvantages for introducing new technologies to the life of a society or community;
- role(s) assumed by technicians (if any) in attaining social acceptance of technical projects;
- possible role(s) assumed by experts from social sciences.

Students in groups will have 15 minutes to complete the PP document template, which will ensure formal comparability of both presentations.

Activity 5:
Presentation of results & debriefing

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST1-AM4-reading tips**
Required accessories	Computer, projector
Time allocation	25 min
Learning outcomes	Improved competence to perceive and identify social impacts of technologies, improved competence to perceive citizens as users of technologies.

After the exercise, one or more representative(s) from each group present conclusions they arrived at. Each group has 10 minutes for their presentation including the following discussion. The teacher leaves free room for students to express their views and react to one another. At the very end of the session, the teacher summarizes the lessons learned, provides feedback and evaluates students. He or she refers to the findings, impulses and difficulties encountered in the course of the given session, but may also contextualize them and point to some general trends. The interest in participative approaches is currently flourishing in response to the diffusion of technologies of all sorts. On the other hand, the use of technocratic approach remains to some extent indispensable. The students need to realize that there is an important difference between a fact and an opinion. The question is rather to strike balance between technocratic and participative approach.

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e) Additional resources

No.	Author and title	Description
1.	Beck, Ulrich. 1992. Risk Society. Towards a New Modernity. London: SAGE, pp. 17–84.	The first part of the book provides a classical sociological analysis of risks imposed on societies in the face of emerging technologies.
2.	Latour, Bruno. 1987. Science in Action. How to Follow Scientists and Engineers Through the Society. Cambridge (Massachusetts): Harvard University Press.	The book is an example of a study that focuses on the work of scientists and engineers from the sociological point of view.
3.	Bruns, Anje, Kira Gee. From State-Centred Decision-Making to Participatory Governance. "GAIA - Ecological Perspectives for Science and Society" 2009, Vol.18, Issue 2. DOI: 10.14512/gaia.18.2.13	This article explains the participative approach to the decision-making by the way of example. It focuses on the planning for offshore wind farms and on the implementation of the Water Framework Directive in Northern Germany.

Session 2:

The conflict between industrial past and environmental values

a) Session objectives

This session teaches students to recognize that the emergence of modern societies was conditional upon the usage of energy technologies in the era of industrialization and that the current discussions about energy transitions largely concern the values that today's societies are to invest in their future existence.

b) Session scope

With this session, the module moves from the general area of science and technology to topics related specifically to the energy sector. Energy facilities and infrastructures contributed a great deal to the modern industrial development, as the supply with energy conditioned technical advancements in many other areas of public, commercial and private life. Humankind mastered the exploitation of natural forces as sources of energy in a historically unprecedented manner (Smil 2006). Since the 19th century, the extensive mining and burning of coal have produced power and heat and changed the standards of economic production and living. In the 20th century and notably in its second half, European populations have gradually gained access to electricity networks and the usage of further fossil fuels has been increasing all the time.

Because of the immense and evident benefits of this vast industrialization process, there are positive values attached to it. Nations competed in technological achievements and have been successfully experimenting with new ways of energy production. Peaceful utilization of nuclear fission since the 50' has been another milestone. For some time, it was possible to perceive the development unequivocally as a pathway of progress, which prompted cultural identification in the majority of populations. People could do the laundry in the washing machine, store products in the refrigerator, watch TV and video, travel comfortably and fast by car or plane and so on. Perhaps more importantly, power production helped to fight poverty, increase dignity of disadvantaged individuals and provide support in the hardest labor. Thanks to the machinery and power, almost the whole population got access to heat, running water and more varied food, and a sufficient number of hospitals and schools could be built.

A business model was set up, in which coal played the key role in securing electricity and heat and petroleum and its derivatives were used to power various transportation means. To make this model functional, a large system of energy production and distribution infrastructures had to be put in place. During the 70' and 80', however, various signs of dysfunctionality have begun to appear in this business model.
Within the energy sector in Europe, they emerged especially in connection with a series of economic oil crises, with raising emissions of greenhouse gases, with all kinds of pollution and environmental damages and with international repercussions of the Chernobyl nuclear

disaster. All these events and processes revealed the fragility of the system, where many countries depended on scarce energy resources imported from abroad. They laid bare an uncomfortable, but pressing fact that the rapid development of energy technologies has unintended consequences threatening the diversity of nature on earth and possibly human existence as such.

In last decades, these unpleasant findings led to the international and global search for technological solutions that would enable transition to a more sustainable energy production. Renewable energy resources have been augmenting their shares in national energy mixes everywhere in Europe. However, to erect energy systems took a lot of time and effort in the past; they are very robust now and not so easily susceptible to substantial changes. Besides, energy facilities and infrastructures are widely interdependent and this interdependence crosses state borders. The heritage of industrial past is embedded in the world we live in and implementation of innovative energy solutions will require not only stepwise reconstruction and dismantling of existing facilities and infrastructures, but also changes in cultural values, ways of thinking and patterns of behavior. . The teacher can also mention the economic issues linked to the transfer from fossil to sustainable power production, especially their hidden externalities (e.g., hidden costs of fossil power, including the cost of greenhouse gasses, distortions of the marked due to subsidized commodities etc.).

» *Where the future will take us? At present, the energy transition is underway together with the quest for decarbonisation and shift to a more environmentally friendly ways of energy production and consumption. Nevertheless, there is still a great number of variables and uncertainties influencing the development and it is much less clear, what kind of energy systems will replace the ones predominant in our days. The session describes the situation from the SSH point of view and employs an Oxford-style debate to explore the variety of arguments related to the project of energy transition and its impacts on European societies. It especially focuses on the role of nuclear energy.*

c) Pre-reading

No.	Author and title	Description
1.	Agora Energiewende. 2017. The Energiewende in a nutshell. https://digital.zlb.de/viewer/rest/image/16284748/Agora_The_Energiewende_in_a_nutshell_WEB.pdf/full/max/0/Agora_The_Energiewende_in_a_nutshell_WEB.pdf	This document presents a comprehensive description of the German “Energiewende”, which is written in a rather affirmative manner, but addresses also some of the critiques.

No.	Author and title	Description
2.	FORATOM. What people really think about nuclear. "ATW – International Journal for Nuclear Power" 2017, Vol. 63, Issue 3. https://www.kernd.eu/kernd-wAssets/docs/fachzeitschrift-atw/2017/atw2017_03_157_What_People_Really_Think.pdf	Continuous production of energy from coal in Germany seems to be in contradiction with the transition to renewables. The document explains why this situation occurs and what the prospects for its change are.
3.	FORATOM. What people really think about nuclear. "ATW – International Journal for Nuclear Power" 2017, Vol. 63, Issue 3. https://www.kernd.eu/kernd-wAssets/docs/fachzeitschrift-atw/2017/atw2017_03_157_What_People_Really_Think.pdf	In contrast to the policy of the German Energiewende, this article presents an argument pleading for the use nuclear energy.
4.	Ministry of Industry and Trade. 2015. State energy conception of the Czech Republic. https://www.mpo.cz/dokument161030.html	The Czech Republic is one of the EU countries that rely on continuous use of nuclear energy in their strategic documents. The Czech Energy Conception is an example of how the argumentation in favor of the nuclear may look like.
5.	United Nations. 2018. Paris agreement. https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement	Global agreement reached within the United Nations Framework Convention on Climate Change in 2015.

d) Session activities

Activity 1:
Energy transition in Germany

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST2-RM1-introductory video**
Required accessories	Computer with internet access, projector, speakers
Time allocation	15 min
Learning outcomes	Understanding of the raising social awareness about environmental impacts of energy production, understanding of the historical conditions of energy development

The session starts in the present-day situation in Europe. In the context of efforts put globally into the search for a political agreement on sustainable development of the planet, the project of energy transition in Germany is highly topical, hotly debated and contested too. The project rests on two key decisions: firstly, to launch stepwise nuclear energy phase-out with view on making energy production safer, secondly, to set ambitious future goals for growing incorporation of renewables into the German energy mix. Yet, the continual reliance of Germans on coal, which is deemed by many to be in fact much less environmentally friendly than the nuclear power, somewhat overshadows the contribution of this pioneering energy strategy to the sustainable development.

The introductory video projection helps the teacher to frame the focus of the session, which will continue with stepwise analysis of the current energy constellation in Europe from the point of view of SSH. In the short discussion after the video, the teacher draws students' attention to the relationship between raising social awareness about environmental impacts of energy production on one hand and the German project of energy transition on the other.

Questions such as these may give direction to the discussion: Why is the environmental awareness so developed in contemporary advanced societies? What caused the widespread perception of environmental issues as urgent? Can we say that energy production is the business sector most responsible for environmental harms in Europe? Is the German project of energy transition an adequate and reasonable response to the present-day situation? Can we say that the project is profitable for the business sector in Germany and in other countries? Finally, yet importantly, is this project in agreement with the vision of sustainability?

Activity 2:
Group work

Methods	Lecture
Keynotes	None
Materials	**M2-ST2-AM1-PP lecture**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the raising social awareness about environmental impacts of energy production, understanding of the historical conditions of energy development.

As of 2019, the global political coordination toward sustainable development is defined by the Paris agreement from 2015 that aims at keeping the global temperature rise in the 21st century below 2 degrees Celsius above pre-industrial levels (and at pursuing efforts to limit the temperature increase even further to 1.5 degrees Celsius) (United Nations 2015).

The vision of sustainable development presupposed by this agreement brings us back to the first session of this module. If undesirable or unintended environmental consequences in general refer to interventions made by science and technology, than their acknowledgement represents an indirect critique of the harmonious relationship between science and society glorified in the modern age. The raising social awareness of energy production technologies doing harm to the environment sheds controversial light on the science itself. However, it needs to be also pointed out that the present vision of distributed sustainable power sources would not be possible without ongoing technological progress, in particular in the domain of distributed measurements, data transfer, communication and grid control.

During last decades, the relationship between societies and their environment has been changing. However, to translate the views about sustainable development into (inter)national energy strategies, policies and effective actions is a long term matter. To a large extent, we still live in a world of energy infrastructures embodying the values of past generations. The first guided lecture in the session points out that the work dedicated to ongoing technical modifications of these infrastructures is at the same time a work by which European nations re-interpret and re-evaluate their industrial past.

Activity 3:
Nuclear energy and sustainable development

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST2-RM2-video on nuclear option**
Required accessories	Computer with internet access, projector, speakers

Time allocation	15 min
Learning outcomes	Understanding of the share of SSH aspects on uncertainty in the energy sector, understanding of the cultural meaning of energy decentralization

Taking into account existing energy infrastructures, available technical solutions and estimated costs, the starting point of energy planning in Europe is that the widespread utilization of renewables, if it proves feasible at all, will require several decades to develop to a stage, when renewables will become a major source of energy production. For the time being, we can leave aside the possibility of nuclear fusion, as its implementation is still in a testing phase. To overcome the transitory period, some European states opt for the nuclear option as sustainable way of energy production. Despite the burden and risks associated with it (esp. the disposal of nuclear waste and the risk of radiation), nuclear energy is deemed to be more sustainable than reliance on coal. Besides other externalities, power from coal causes higher release of radiation than equivalent power from nuclear energy (Hvistendahl 2007).

The preference given to the nuclear option by some European states and its refusal by others generates tensions in international relations. It is obvious that taking attitude to the nuclear is not only a matter of technical expertise. There are values at play; varying values that different nations wish to invest in their future. This conclusion implies potential questions for the discussion in the class: To what values we subscribe, if we opt for nuclear energy? What future societal scenarios this option opens up or makes more likely to happen? Alternatively, what future societal scenarios this option closes or makes less likely to happen?

Activity 4:

Current uncertainties about the energy future

Methods	Lecture
Keynotes	None
Materials	**TM2-ST2-AM2-PP lecture**

Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the share of SSH aspects on uncertainty in the energy sector, understanding of the cultural meaning of energy decentralization.

Nowadays, energy planning in the EU is at the crossroads. On one hand, it seeks ways to part from the industrial past; on the other hand, the ongoing decrease in energy centralization makes the development less organized and uncertain. Innovative technologies are evolving fast and their prices go down. Various business groups keep lobbying for their interests and want to have their share in the profits coming from implementation of new energy strategies. Wide-ranging business with scarce energy resources shapes international relations and policies. Citizens as individuals and communities learn to think in new terms about energy savings, self-production or prosumption. Due to all these change-generating mechanisms, it becomes difficult to predict future development, which will likely emerge rather unpredictably from ongoing interactions among all of them.

The continuation of the guided lecture draws attention of students to the future of the energy sector and unveils the social and cultural scale of the current situation. It highlights that the idea of energy decentralization assumes its cultural meaning within the life of communities, which often welcome the opportunity to break up with the dependence on the central energy supply. At the same time, it is worthwhile to take into account different conditions at sparsely populated countryside with smaller towns on one hand, and cities and industrial centers on the other.

Activity 5:

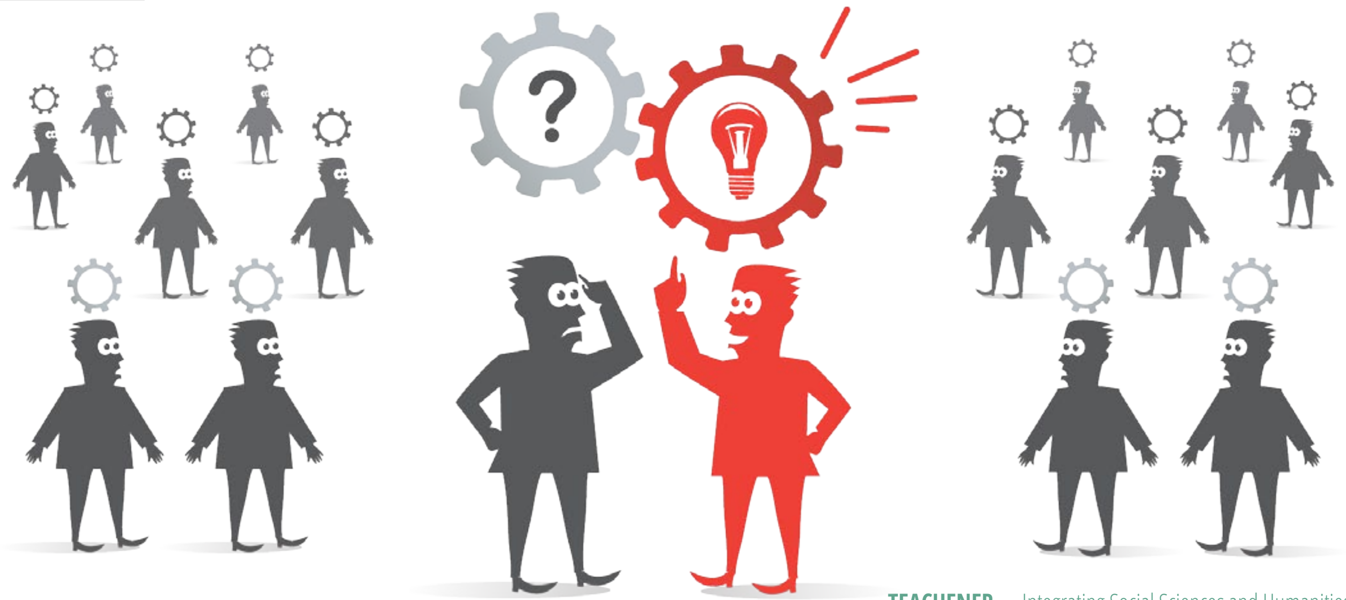
What is Oxford debate?

Methods	Lecture, discussion
Keynotes	None

Materials	**TM3-ST2-AM3-PP Oxford debate**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the procedure of the Oxford-style debate

The teacher presents the procedure of the Oxford-style debate as a tool for organizing exchange of opposing views on various matters. The aim of the debate is not to determine the truth, but rather to seek arguments, defend them, and thus test their weight. The teacher stresses the importance of sticking to the rules of the debate and checks that everybody understands these rules accordingly.

» *The subject of the debate in this session will be to argue in favor and against nuclear energy as a means for transition to a sustainable energy production. The teacher asks students to split into three groups (first two consisting of at least two, the third of three participants): group 1 – presenting the thesis about the nuclear energy and advocating it; group 2 – opposing the thesis; group 3 or the jury, which may ask questions and makes the verdict at the end, i.e. determines, whether the group 1 or 2 is the winner of the debate. Teacher and students organize the space so that each group can work separately without disturbing other group(s).*



Activity 6:
Getting ready for the Oxford debate

Methods	Presentation, group work
Keynotes	None
Materials	**TM2-ST2-AM4-in favor of nuclear energy** **TM2-ST2-AM5-against the nuclear energy** **TM2-ST2-AM6-handout**
Required accessories	Printed materials (one copy for each student).
Time allocation	30 min
Learning outcomes	Improved competence to verbalize non-technical views and observations

» *AFTER THE BREAK, STUDENTS SPLIT INTO THREE GROUPS AND ARE SEATED SO THAT IT ALLOWS FOR BOTH SEPARATE WORK WITHIN EACH GROUP AND THE MUTUAL COMMUNICATION AMONG GROUPS.*

At the very outset, it is the task of the teacher to ensure correct understanding of the purpose of the debate and prevent it from falling to too narrow technical terms. The point at issue is not so much technical facts or calculations speaking in favor of or against energy strategy of any kind. Albeit this information may help to present the arguments, the goal is to pursue and comprehend the interconnection of energy scenarios with values attached to technology and impacts these technologies are likely to have on the society.

The debate will be framed as a confrontation between the German (pleading for renewables) and the Czech (pleading for the nuclear) energy strategy. The teacher gives group 1 and group 2 an excerpt from the respective strategic document and tells them they have 20 minutes to analyze available information and formulate their arguments. The teacher also specifies what level of technical detail is acceptable in the debate – expertise beyond this level will be allowed only if it is properly explained. Contrary to groups 1 and 2, members of the group 3 will obtain both excerpts and will read them to prepare for their critical role in the debate.

Activity 7:
The role of the nuclear in energy transition

Methods	Oxford debate
Keynotes	None
Materials	**TM2-ST2-RM7-reading tips**
Required accessories	Computer, projector
Time allocation	60 min
Learning outcomes	Improved competence to articulate and defend views in public communication about energy

Teacher acts as a chairperson or as a ‘marshal’, who is in charge of the debate, but interferes in it minimally. He or she watches the time limit and ensures that each party has its say within the limit.

Round one: first exchange of arguments

- First speaker from the group 1 presents the thesis (5 min).
- First speaker from the group 2 opposes the thesis (5 min).
- The jury joins the debate with critical questions and arguments (10 min).

Round two: second exchange of arguments

Follows the same sequence, but this time with the second speaker from both groups.

The verdict

During the debate, the jury works implicitly and assigns points for each speech: 1-3 points can be assigned depending on the level of the arguments; negative points can be assigned in case of offense. After the exchange of arguments, the jury compiles the verdict based on the points awarded to each group and presents it in secrecy to the marshal, who announces the verdict with a brief justification. Teacher dedicates the final time to the summary discussion of strengths and weaknesses of pronounced arguments.

e) Additional resources

No.	Author and title	Description
1.	Smil, Vaclav. 2010. Energy Transitions. Santa Barbara, Denver, Oxford: Praeger.	Complex elucidation of the phenomenon of energy transitions in the human history.

Session 3:
Energy and ethics

a) Session objectives

The goal of the session is to explore the ethical dimension of energy issues and to train students to become more responsive to problems of responsibility and justice.

b) Session scope

Both previous sessions touched upon the topic of values and culture. The third session follows up and deepens this line of explanation. Its aim is to familiarize technical students with the ethical or moral dimension of energy issues. To be sure, the session cannot fully substitute for an introductory course in general ethics that is likely not to be the part of the curricula on technical universities. Its ambition therefore has to be more modest. It confines itself on outlining the connection between general ethical reasoning and the way ethical problems arise in the decision-making about energy issues. As in all sessions, students interested in learning more about ethics can find reading tips in the attached list of resources.

We can trace ethical phenomena almost everywhere in human social interaction. At least when we search for them, because normally we simply take the order of things around us for granted and do not become aware of the fact that it is a cultural accomplishment. Values shared in a certain community or society are usually closely tied to various rules and norms that people create and impose on themselves in order to organize and regulate their actions. Such rules and norms largely influence our actions implicitly as habits, patterns of behavior or traditions that we acquire and build in everyday intercourse with others. However, in many other times they are explicitly formulated, are considered as more or less binding for members of the society and can exercise power over them, as it is in case of legal norms. As individuals, we find the world full of value and normative structures, which do not always cohere with each other and quite often appear to be in conflict.

This *objective* description, however, says only half of the truth. The second half has much more to do with *subjective* life of individuals placed in the world, where they constantly have to make choices. We all are familiar with ethical considerations from our personal experience. We develop moral views and attitudes; we make decisions about our own actions and judge actions of others. In some cases, it causes us a lot of effort to make up our mind. It may also turn out that we have made a morally wrong decision and would like to take it back or revise it later. These and other things happen from many subjective reasons such as the lack of knowledge, experience or information, the influence of feelings, emotions and prejudices or due to the demands imposed on us by the given situation, which e.g. might have been unexpected, unusual, too complex or required swift reaction not giving us much time to think it through. People's *individual actions* have always been of primary concern to philosophers and other experts occupied with ethical reflections.

The general ethical question regarding what is good or right and what is less good, bad or wrong gets even more complicated, when it applies to *collective action* involving many individuals, groups or institutions. The need for such action is usually triggered by some sort of common problem affecting these diverse stakeholders, who are pushed to seek a solution together and share the responsibility. To agree on a solution, to carry it out successfully and mostly also to translate it into rules and norms that members of the given society will accept and stick to in the future is often challenging and difficult to achieve. What deserves attention in our context is that tackling problems related to energy issues usually requires collective action, whereas individual action appears as rather secondary.

» ***ENERGY ETHICS** REPRESENTS A RELATIVELY NEW AND EVOLVING BRANCH OF APPLIED ETHICS, WHICH RELIES ON THE FUNDAMENTAL CONCEPTS OF GENERAL ETHICS AND ELABORATES ON THEM IN SPECIAL AREAS OF ENERGY PRODUCTION, DISTRIBUTION, CONSUMPTION, WASTE MANAGEMENT AND ENERGY FACILITIES DISMANTLING.*

In the view of energy ethics, the *actors* making morally relevant decisions represent different types of energy stakeholders: various governance bodies and state institutions; corporations; scientists, technicians and experts of many professions; nongovernmental organizations; municipalities; civic initiatives; communities of users; and of course, in the last instance individuals and their households. The task of energy ethics consists in providing energy stakeholders with ethical expertise related to decisions about energy strategies and policies and to particular energy projects.

Once again, in this module, it is important to underscore that also in case of energy ethics the crux of the matter is non-technical in its very nature. When principal ethical questions arise in debates on various energy issues, they concern not so much the selection of proper (technical) means for attaining certain ends. They concern rather the ends themselves, the value of which motivates what we do.
It is clear that energy ethics present a challenging and inconclusive subject, sometimes counterintuitive, where insufficient education can cause unintended damage to the environment. From the viewpoint of power engineering, the questions of energy efficiency in production, storage and consumption should be considered together with questions of pollution, including thermal pollution or production of greenhouse gasses. From the viewpoint of economy, the issue of a low ratio of research and development to the power industry turnover should be pointed out, with serious consequences on the free market due to the system of subsidies to the progressive energy sources. The ethical questions of individual actions are also significant, including the readiness of individuals to invest into energy and water saving options at home (MacKay 2009).

Engineer's note on ethics of energy

Energy facilities (mines, power plants, distribution grids etc.) are usually very expensive and have a lifetime of many decades. For these reasons, decision-making about their construction is a significant act of societal importance and a large responsibility that lies with stakeholders.

If one of the stakeholders in this process does not proceed ethically, it can cause a waste of public funds, damage to the environment or endanger human lives. Such unethical behavior may be to prioritize personal interests over a rational and objectively beneficial solution. The corruption by officials in deciding on the construction of new power plants, which can forcefully suppress the view of environmental organizations, can lead to widespread environmental damage. For example, it is unclear whether there was an ethical mistake when signing a contract to build the US Three Mile Island power plant with a company without sufficient experience, which could be one of the causes of the nuclear accident.

Similarly, ethics applies also to environmental organizations promoting rational ecological measures. We may, e.g., ask, whether the activists themselves meet the proclamations of tens of percent reduction in power consumption that they voice publically.

Ethics of energy also plays an important role in the operation of energy facilities. Ethical misconduct is behind the Chernobyl nuclear accident, where senior decision-makers favored the interest of several people over security rules and consciously disconnected reactor safety systems.

c) Pre-reading

No.	Author and title	Description
1.	Sovacool, Benjamin. 2013. Energy & Ethics. Justice and the Global Energy Challenge. Cham: Palgrave Macmillan, pp. 218–227.	The concluding chapter of the book outlines key elements of the concept of energy justice: availability, affordability, due process, information, prudence, intergenerational equity, intragenerational equity, responsibility.

d) Class activities

Activity 1:
Ethical dimension of energy issues

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST3-RM1-introductory video**
Required accessories	Computer with internet access, projector, flipchart (board)
Time allocation	20 min

Learning outcomes	Understanding of the ethical dimension of energy issues

It is possible that some students at technical universities have not given sufficient thought to possible ethical questions related to energy issues. The teacher cannot expect much knowledge of the topic on their side. The video projection at the beginning of the session familiarizes students with some of the ethical considerations regarding energy. After this initial information, students should be able to roughly follow up and think themselves about other possible examples of ethical problems.
The teacher opens up the discussion with stimulating questions such as: Have you ever come across ethical problems related to energy? Even if it is not the case, can you fancy such problems, when you think about ethics? If you take into account various energy resources and compare them, which of them are more likely to arouse ethical considerations? Can you explain why or in what sense? The discussion serves as the first exploration of the topic. The teacher may record the findings of the discussion on the board or flipchart, comment on them or even return to them during the later interactive exercise.

Activity 2:

General ethics and energy ethics

Methods	Lecture
Keynotes	None
Materials	**TM2-ST3-AM1-PP lecture**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the relationship between general ethics and energy ethics, understanding of the problems concerning responsibility and justice related to energy issues

At the beginning of the lecture, the teacher familiarizes students with the basic definition of ethics. Then he or she proceeds to the application of general ethical considerations in the field of energy issues. Two basic topics are distinguished: first one concerning ***responsibility*** and the second one concerning ***justice***.

In this respect, the teacher may wish to exemplify the terms of responsibility and justice, including difficulties in their perception, on a real case. Among many different major incidents in the history of power production, the teacher can present the tragedy of the Vajont dam in Italy in 1963, which killed more than 2000 people.

From the ethical point of view, energy projects, facilities and infrastructures represent results of actions intervening in the environment and in the social relations. It is possible to evaluate them comparatively as good or bad, responsible or irresponsible, just or unjust. They intervene in the environment, because they – as it is well known – change the landscape and influence natural processes on the local and cumulatively on the global level as well. In the past, this often entailed negative effects and externalities. Moreover, they intervene in the social relations, because these relations adapt to the environmental changes and in response to emerging technological innovations generate their own mechanisms of peoples' reasoning, decision-making, acting or doing business. Ethical problems of responsibility in energy are tied to the history of societies and comprise three temporal dimensions or responsibility:

- Who, if anybody, can be hold responsible for effects of energy related decisions and policies made in the past?
- How should we decide about energy and design energy policies in the *present-day* world?
- As *future* generations will face the effects of our actions, how should we act with regard to the people that will inhabit our world after us?

The concept of energy justice approaches the ethical phenomena from a different angle. Existing evidence supports a quite straightforward rule of proportion saying that introduction and widening of energy supplies means improvement in quality of life. This is especially the case with electricity. In general, production and distribution of electricity brings good to any community or society. In this regard, energy justice applies firstly to the obvious disparity between one part of the global world, where constant supplies with electricity and other energy resources are taken for granted, and the rest of the world, where access to electricity and other resources are distributed selectively or is not available at all.

Secondly, energy justice applies also to the phenomena that are peculiar to contemporary advanced societies: Is the decision-making about energy governed by the due process? Is the information that the public has about energy transparent and trustworthy? Is the information understandable to the lay public? Are the stakeholders sufficiently educated and informed? If not, how can the power industry contribute to their education? Can all people in the present-day afford to consume energy in accordance with their needs, or is there some inequality? Will the next generations also be able to enjoy the same level of living standards as we do? During the last decade, the awareness of the energy poverty has been growing in the EU states (see the website of EU Energy Poverty Observatory: www.energypoverty.eu).

Activity 3:
Energy responsibility and justice

Methods	Group work
Keynotes	None
Materials	**TM2-ST3-AM2-handout** **TM2-ST3-AM3-PP group work**
Required accessories	Computers operated by students, printed handouts
Time allocation	25 min
Learning outcomes	Competence to consider questions of responsibility in energy issues, competence to consider questions of justice in energy issues.

In the next activity, students are going to practice the knowledge of energy responsibility and justice in group work. The teacher asks students to divide themselves in groups (max 5 students in each group) and distributes to all students a handout summarizing the key findings about energy responsibility and justice. The task of each group will be to select and assess ethically one source of energy production in their home country or region, e.g. coal, nuclear, solar, wind, gas or thermal energy. Each group will complete the ready-made PP template.

Activity 4:
Presentation of results & debriefing

Methods	Presentation, discussion
Keynotes	None
Materials	**TM2-ST3-RM4-reading tips**
Required accessories	Computer, projector
Time allocation	25 min
Learning outcomes	Competence to consider questions of responsibility in energy issues, competence to consider questions of justice in energy issues.

Representative(s) of each group use(s) the completed PP document template to present results of the group work. After each presentation, students from other group(s) have room to comment on the presentation, express their views and ask questions. To help students to understand the point of the session, the teacher uses the remaining time to check the impressions they have from the exercise: Was it easy or not for you to make ethical judgements about energy? Up to what extent is it possible to assess separately one particular source of energy with exclusion of others? Is it possible to come to unambiguous conclusions? Who should bear the responsibility for ethical considerations in energy projects? What should be the role of technical experts?

e) Additional resources

No.	Author and title	Description
1.	Jonas, Hans. 1985. The Imperative of Responsibility. In Search of an Ethics for the Technological Age. Chicago, London: The University of Chicago Press.	The book rethinks the foundations of ethics in light of the awesome transformations wrought by modern technology: the threat of nuclear war, ecological ravage, genetic engineering, and the like.
2.	Marshall, Alan. The social and ethical aspects of nuclear waste. "Electronic Green Journal" 2005, Vol. 1, Issue 21. https://escholarship.org/uc/item/2hx8b0fp	The article elucidates ethical considerations framing the problem of the disposal of nuclear waste.

Assessment methods and final assignment

Assessment of the collective work

During the sessions, students complete their main tasks in groups (up to 5 students in each group). In each session, the teacher assesses the performance of the group. Individual students get the same percentage score as their group fellows. Groups do not change; each student remains a member of one group in all sessions.

The teacher uses the following assessment tables and issues a separate table to each group for its activity in the given session. In each row indicating one aspect of the group performance, teacher ticks one column indicating the appropriate percentage score. Teacher counts the final score as the total sum of percentages that the group gets in four specific aspects of its performance (e.g., 25 % + 20 % + 15 % + 10 % = in total 70 %).

SESSION 1: COMPARISON OF APPROACHES TO THE DECISION-MAKING

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Understanding of social impacts of sciences and technologies							Total score
Ability to distinguish between the participative and the technocratic approach							
The role of technicians in attaining social acceptance of technical projects							
The role of experts from social sciences							

SESSION 2: THE ROLE OF THE NUCLEAR IN ENERGY TRANSITION (OXFORD DEBATE)

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Number of arguments put forth in the debate							Total score
Inclusion of social aspects in the arguments							
Solidity and conclusiveness of arguments							
Ability to oppose and criticize							

SESSION 3: ENERGY RESPONSIBILITY AND JUSTICE

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Understanding of ethics							Total score
Understanding of ethical dimension of energy issues							
Ability to think in terms of energy responsibility							
Ability to think in terms of energy justice							

Grading – one session:
100 % - 90 % = A
89 % - 75 % = B
74 % - 60 % = C
59 % - 50 % = D
49 % - 40 % = E
Lower than 39 % = F
In case that more than one session is taught, teacher uses the average score to determine the final grade.

Assessment of the individual work

If the teacher wants to assess students individually as well, he or she may ask them to write an essay. Writing of an essay will help students to expand their knowledge and focus on a special topic. The teacher employs the same grading scheme and can use the average of the collective and the individual score to determine the final grade.
Some suggestions of an essay topic:

- *Who should be responsible for negative social impacts of sciences and technologies?*
- *Is the energy sector the business sector most responsible for environmental pollution?*
- *How should scientists communicate with the lay public?*

Glossary

Science and technology studies (STS)	'is an interdisciplinary field that investigates the institutions, practices, meanings, and outcomes of science and technology and their multiple entanglements with the worlds people inhabit, their lives, and their values' (Felt 2017: 1)
Technocratic vs. participative decision-making	– two approaches to the decision-making about collective action; whereas the first one leans towards the regulation of action by the state administration, the second one endorses the engagement of citizens in the processes of decision-making and proposes practises for organizing such engagement.
Sustainability	– 'the long-term viability of a community, set of social institutions, or societal practice. In general, sustainability is understood as a form of intergenerational ethics in which the environmental and economic actions taken by present persons do not diminish the opportunities of future persons to enjoy similar levels of wealth, utility, or welfare.' (Meadowcroft et al. 2019).
Ethics	'also called moral philosophy, the discipline concerned with what is morally good and bad, right and wrong. The term is also applied to any system or theory of moral values or principles' (Singer et al. 2018).

Attachment: Syllabus

1. Name of the Teaching Module

Philosophy And Ethics Of Energy Development

2. Brief description of the subject matter

The development of energy technologies is linked with a more general view of natural sciences and technologies and their function in modern societies. Environmental values of contemporary European societies often seem to be in conflict with their industrial past.

Exploitation of energy resources brought about an unprecedented improvement of standards of living. At the same time, the expansion of technologies for energy production and distribution also had a number of large social and environmental impacts and generated risks and unintended consequences. Today the awareness of these problems encourages search for future strategies of energy development not only in terms of new efficient technologies, but also in terms of cultural values and reorganization of social relations. This process carries along ethical challenge including various dimensions of responsibility. In contemporary world, where energy becomes an ever-present precondition for most of our activities, it is also about time to start to think about energy justice.

3. Complete SSH problems description

- The function of science and technology in modern societies; social impacts, risks and unintended consequences of technologies; citizens as users of technologies.
- Historically inherited energy infrastructures, raising environmental awareness; current political and economic uncertainties; social and cultural contexts of future energy development; renewables and nuclear energy as competing strategies.
- Application of ethics in the field of energy; energy justice and responsibility, evolving ethical and cultural values related to energy.

4. Prerequisites

There are no prerequisites except the interest for the theme. The module is intended for master and PhD students. But also bachelor students may attend.

5. Learning outcomes

a. Knowledge

Students will learn how social sciences and humanities understand the relationship between natural sciences and technologies on the one side and modern societies on the other. They will discover historical, social and cultural conditions influencing current discussions about energy transition. And they will familiarize basic terminology for gaining insights into ethical aspects of energy issues.

b. Skills

Group works and discussions will encourage students in their own exploration of social impacts of natural sciences and technologies. They will build competences to perceive social, cultural and ethical aspects of energy issues. They will be guided to reason about values lying behind energy policies and decision-making.

c. Social competencies
Group works and discussions will help students to verbalize their non-technical observations and to articulate and defend their views in communication with others.

6. Form of classes

- The module consists of three interlinked sessions. To explore thoroughly the area of energy and the public, it is recommended that the stages follow one after another connectedly or in three single days. However, each stage is optional and it is also possible to select only one separate stage without going through the others.
- Sessions combine guided lectures with interactive elements and group exercises. Sessions 1 and 3 are scheduled for 90 minutes (two teaching hours). Session 2 includes organization of the Oxford-style debate and takes 180 minutes (four teaching hours). Recommended pre-class readings and additional sources for self-study are available for each session.
- Each session is accompanied with pre-readings, which help teacher to prepare for the class. Pre- readings may also be suitable and useful for students attending the class. Teacher may assign students to read some of them before the class. Additional references to specialized literature and other sources give both teacher and students hints for expanding their knowledge in particular fields of interest.
- Optimal number of students is from 6 to 15 in the class.

7. Teaching methods

- PP presentations,
- case studies,
- group exercises,
- Oxford debate,
- class discussion,
- pictures,
- videos.

8. Detailed classes plan

Stage 1: Natural sciences, technologies and modern societies
Contents:

- modern conception of science and technology,
- modern societies and the role of scientists and technicians,
- technologies as generators of social change,
- risks and unintended consequences of technologies,
- citizens as users of technologies,
- technocratic and participative decision-making.

Stage 2: The conflict between industrial past and environmental values
Contents:

- environmental awareness and sustainable development,
- historically inherited industrial infrastructures and energy production,
- uncertainties in today's energy markets and policies,
- social and cultural contexts of energy centralization and decentralization,
- competing strategies: nuclear energy and renewables.

Stage 3: Energy and ethics
Contents:

- ethical dimension of energy issues,
- general ethics and energy ethics,
- energy projects as actions intervening in the environment and in the social relations
- responsibility concerning energy issues and its temporal dimensions
- energy justice.

Required materials & equipment

- Power Point presentation,
- computer, projector,
- flipchart or board,
- internet connection.

9.Literature and other materials

1. Natural sciences, technologies and modern societies

1.1. Beck, Ulrich. 1992. Risk Society. Towards a New Modernity. London: SAGE.

1.2. Felt, Ulrike et al. 2017. The handbook of science and technology studies. Cambridge – London: The MIT Press.

2. The conflict between industrial past and environmental values

2.1. Hvistendahl, Mara. Coal ash is more radioactive than nuclear waste. "Scientific American" December 2007. https://www. scientificamerican.com/article/coal-ash-is-more-radioactive-than-nuclear-waste/.

2.2. Mackay, David. 2009. Sustainable energy without the hot air. Cambridge: UIT Cambridge. https://www.withouthotair.com/.

2.3. Meadowcroft, James et al. 2019. Sustainability. Encyclopædia Britannica. https://www.britannica.com/science/sustainability

2.4. Morris, Craig, Arne Jungjohann. 2016. Energy democracy. Germany's Energiewende to renewables. Cham: Palgrave Macmillan.

2.5. Papaefthymiou, George, Ken Dragoon. Towards 100% renewable energy systems: Uncapping power system flexibility. "Energy Policy" 2016, Vol. 92, pp. 69–82. DOI: 10.1016/j.enpol.2016.01.025.

2.6. Piria, Raffaele et al. 2014. Greening the heartlands of coal in Europe. Insights from a Czech-German-Polish Dialogue on Energy Issues. Heinrich Böll Stiftung. https://www.boell.de/sites/default/files/greening_the_heartlands_of_coal_in_europe.pdf.

2.7. United Nations Economic Commission For Europe. 2014. The Aarhus Convention. An implementation guide. Geneva: UNESCO / UNECE. https://www.unece.org/env/pp/implementation_guide.html.

3. Energy and ethics

3.1. Kermisch, Celine. Specifying the concept of future generations for addressing issues related to high-level radioactive waste. "Science and Engineering Ethics" 2015, Vol. 22, Issue 6, pp. 1797–1811. DOI: 10.1007/s11948-015-9741-2.

3.2. Singer, Peter et al. 2018. Ethics. Encyclopædia Britannica. https://www.britannica.com/topic/ethics-philosophy.

3.3. Soutar, Iain, Cetherine Mitchell. Towards pragmatic narratives of societal engagement in the UK energy system. "Energy Research & Social Science" 2018, Vol. 35, pp. 132–139. DOI: 10.1016/j.erss.2017.10.041.

3.3. Soutar, Iain, Catherine Mitchell. Towards pragmatic narratives of societal engagement in the UK energy system. "Energy Research & Social Science" 2018, Vol. 35, pp. 132–139. DOI: 10.1016/j.erss.2017.10.041.

3.4. Sovacool, Benjamin et al. 2014. Energy Security, Equality, and Justice. London – New york: Routledge.

3.5. González-Eguino, Mikel. Energy poverty: An overview. "Renewable and Sustainable Energy Reviews" 2015, Vol. 47, pp. 377–385. DOI: 10.1016/j.rser.2015.03.013.

TM3

Energy and the public

How societies communicate and decide about energy issues?

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Introduction

We all depend on continuous energy supply in our day-to-day activities. As people living in the EU states we take it for granted that a source of electricity will be there whenever we need it. It is a considerably less self-evident matter, how the electricity we rely on is supposed to be produced and distributed.

» *The energy sector stands at a crossroads today and newly emerging options of energy strategies challenge the old ways of doing the business.*

Other teaching modules, especially the one dedicated to philosophy and ethics of energy development, explore some of the systemic mechanisms behind this change: raising environmental awareness, the influx of technology innovations and its reflection, and wide-ranging business with energy resources shaping the international relations.

This module approaches technical students as potential future energy experts, who will need to integrate social or societal aspects of energy issues into their expertise and decision-making. Its focus is twofold: on people as stakeholders in energy issues and on policies and practices of energy governance. These are two sides of the same coin. Albeit this process occurs gradually and inconspicuously. Individuals, communities and businesses

» *learn to think about energy production and consumptions in new terms.*

They explore new views, practices and values, seek opportunities, change their patterns of behavior, but also feel uncertain about future development, and are sometimes concerned. Energy policies, projects and facilities attract attention, spark public debates and provoke protests. On the other hand, the evolving multi-level political framework of energy governance in the EU conditions this gradual process, in which people assume the role of stakeholders in energy transition. Their engagement depends on policies, (inter)national authorities, state institutions and legally binding rules of the game.

» *The study of the interconnection between energy stakeholders and energy governance obviously goes beyond the purely technical way of reasoning.*

Energy experts seriously interested in this vast subject can hardly bypass the contribution of social sciences. The aim of this module is to present an introduction, which conveys basic knowledge of the subject and teaches competences and skills that technical students may benefit from in practice. The scope of the module is necessarily selective and by no way covers the subject in detail and complexity. It functions rather as a general overview that opens the door for students to follow up various specialized topics according to their own interests. The module is divided in three sessions explaining how to study public opinion about energy, how the energy governance in the EU in general works and how stakeholders can participate in the decision-making about energy issues.

The teaching module is composed of 3 successive sessions:

The module consists of three interlinked sessions. To explore thoroughly the topic of the module, it is advisable that all three sessions follow one after another connectedly or in three single days. However, each session is optional and it is possible to select only one separate session without going through the others. Sessions combine lectures and presentation of materials with interactive elements and with group and project work.

1

Session 1: Public opinion on energy issues in a nutshell
explains, what are public opinion surveys and how to read social data related to energy issues.

90 minutes

2

Session 2: Energy governance in the EU and its stakeholders
provides a basic overview about the energy governance in the EU and focuses on the concept of energy stakeholder

90 minutes

3

Session 3: Communication among stakeholders and their participation in the decision-making
is devoted to the communication among stakeholders, introduces an array of practices for participation of stakeholders in the decision-making and trains students to use them.

180 minutes

Pre-readings help the teacher to prepare for the class and may be suitable for students attending the class as well. The teacher may assign students to read some of them before the class.

Session 1:

Public opinion on energy issues in a nutshell

a) Session objectives

Students will learn the basic principles of public opinion survey methodology and will gain competence to read and interpret the reports presenting social data related to energy.

b) Session scope

Monitoring and regulation of energy systems produce plenty of data about all kinds of customers connected to energy distribution grids or otherwise utilizing the existing infrastructures. However, sometimes energy experts may want to learn more about people's views, values and expectations or about patterns of behavior and facts that cannot be read from the "hard" data generated by the operation of energy systems themselves. How to proceed in case we are interested in such social data? In general, we need to contact the people from our target group or population, ask them questions we are concerned with and analyze their answers. An efficient and reliable way to accomplish this is to design and conduct some kind of empirical sociological research. There is a rich array of methods we may choose from and apply in such research according to what we want to find out and according to whether our target population consists of individuals, households, companies, municipalities or otherwise defined communities of energy users. Sociological research can be very inventive and creative in finding ways for reaching almost any possible group we want to study.

Data in engineering and social sciences

The teacher may remind students of important features of technical data, such as the data volume, dynamical range, and accuracy, statistical and systematic errors. Sometimes, technical data give evidence of social phenomena: e.g., it is possible to read the data about electricity consumption of households as an information about patterns of behavior related to electricity appliances. In other cases, accessibility of technical data triggers important legal and social issues on privacy and copyrights. If your car registers your driving preferences, may your car service know? May your insurance company know?

Social data differ from technical data considerably. They are mostly an aggregate result of questionnaires or interviews with individual people (respondents). An important difference lies also in the fact that in public opinion surveys, we usually do not have data about the whole population, but only work with a sample of respondents representing the given population. However, even purely social data may convey interesting information concerning technologies. E.g., we may ask individuals, households, municipalities, companies to indicate, what electricity appliances they have, how they use them, how difficult is it for them to pay the bill for electricity supplies etc.

This session focuses on one particular type of sociological research, namely on public opinion survey (Davison 2017). The reason for this choice is that the public *opinion survey* is commonly regarded as the best-known product of sociological knowledge, the results of which are often included in various reports and expert documents and appear also frequently in the media. The subjects of these surveys may be very diverse and extend to the area of energy and technologies in general. It is therefore useful even for energy experts or technicians, when they are aware of the methodological principles behind the public opinion surveys and are able to read and understand correctly the resulting social data.

Facts or opinions?

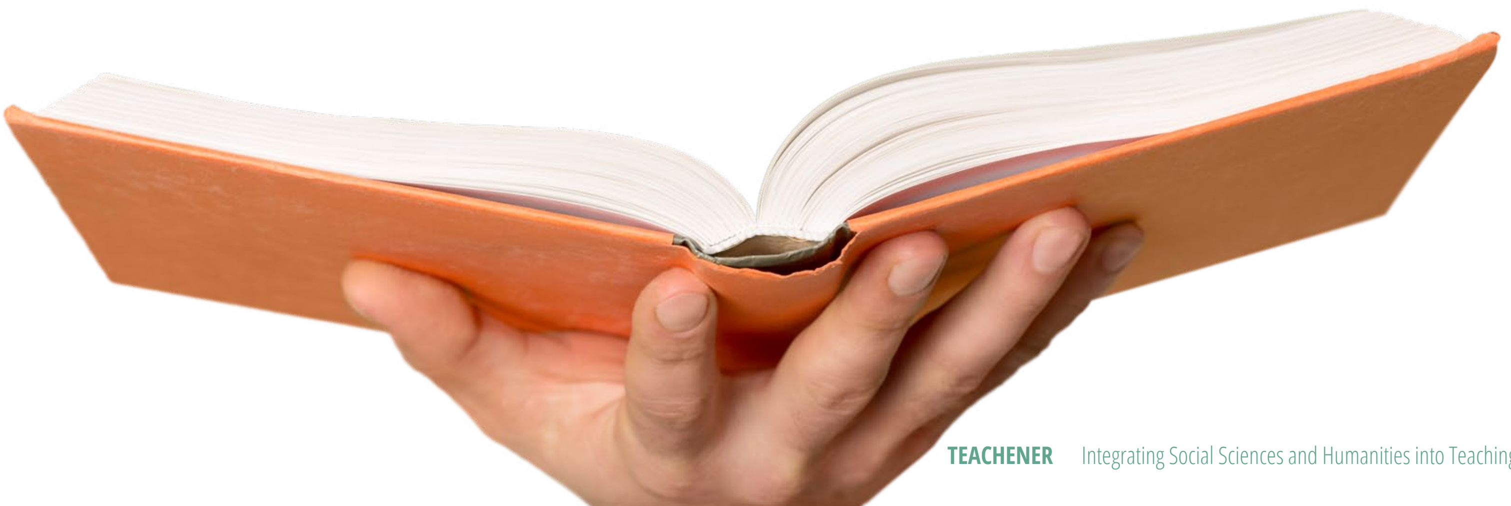
Many engineering students tend to underestimate the importance of social data with respect to technical data. The teacher might wish to explain students that indeed, knowledge is superior to public opinion, however, public opinion is often decisive. It is important to point out that survey of public opinion follows rigorous methodology, in many respects similar to technological standards – social data are analysed with statistical methods, and as a result, we learn facts on public opinion. This knowledge is then instrumental for informed communication with the public.

Public opinion surveys are based on quantitative methodology (Babbie 2009). They use questionnaires to collect data from a number of respondents large enough to provide for the possibility of their analysis in statistical terms and for the possibility to generalize from the limited sample of respondents to the population as a whole. Outputs of the surveys usually take on the form of various tables, graphs or summary indicators. Many people are impressed by this ability of quantitative methodology to reduce the complexity of social matters and squeeze it in a few simple and straightforward figures. Others are more cautious and point out that this bringing of sociology closer to the methods of measurement common in natural sciences has to be taken with a grain of salt. The best way to appreciate duly the assets that public opinion surveys offer as means for acquiring information on populations or societies is to avoid both their over- and underestimation (Poynter 2016).

The session does not burden the technical students with detailed elucidation of multiple steps comprised in the methodological procedure of designing, conducting and evaluating the results of the survey. It confines the theoretical explanation to a minimum necessary for the students to get an idea of what all is going on in this type of sociological research. The main emphasis is put on their building the practical competence to read reports containing social data and assess relevance of these data for the decision-making about energy issues.

c) Pre-reading

No.	Author and title	Description
1.	Davision, W. Phillips et al. 2017. Public Opinion. Encyclopædia Britannica. https://www.britannica.com/topic/public-opinion	This text clarifies the history and meaning of the tricky concept of public opinion and explains the method of public opinion measurement.
2.	Babbie, Earl. 2009. The practice of social research. Belmond: Wadsworth, pp. 253–295.	The book is a standard introduction to the methodology of social research. The selected chapter is dedicated to the survey methodology.
3.	Poynter. 2016. Understanding and interpreting polls. POYNTER. https://www.poynter.org/shop/self-directed-course/understanding-and-interpreting-polls-international/	This online crash course is for journalists and any lay persons working with the survey data. The course gives better understanding of how polls are conducted, what to look for in the methodology and how to determine the objectivity of a poll.



d) Session activities

Activity 1:
Overview of the survey methodology

Methods	Presentation, discussion
Keynotes	None
Materials	**TM3-ST1-RM1-introductory video**
Required accessories	Computer with internet access, projector, speakers
Time allocation	15 min
Learning outcomes	Understanding of the basic principles of public opinion survey

At the outset of the session, the teacher plays a video summarizing the basic information about public opinion surveys. The video introduces students briefly and efficiently to the topic that will be subject of further explanation in the following lecture. In the discussion about the video, teacher focuses on encouraging interest in the topic and on interconnecting it with the role of technical experts. Questions such as these may stimulate the discussion: Do you know the method of public opinion surveys from your own experience? Do you consider such surveys as a relevant source of information about other people's views? Do you think they can be important for energy experts? The discussion should get to the point, when energy issues are explicitly considered in connection with surveys. Then it will be easier for the teacher to proceed to the next activity, which starts with marking off this connection in general terms.

Activity 2:
Procedure of the public opinion survey

Methods	Lecture
Keynotes	None
Materials	**TM3-ST1-AM1-PP lecture**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the methodology of public opinion survey

In any field of human and social life, people with views on various matters associated with their activities, develop knowledge, behave or act in a certain way, make value judgements, perceive and take into account various facts. This happens in relation to energy issues as much as to any other issues people may be concerned with. The concept of public opinion spells out the practical need to find out, what "people" think, what they value, how they are likely to behave.

» *In the energy sector, the data about public opinion may be very useful for making informed and socially adequate decisions.*

Even though questionnaire surveys mostly do not guarantee a perfect knowledge, they offer a tool to understand better than if we rely on selective information. Results of such surveys may be helpful in shaping decisions about energy policies, projects and facilities.

The purpose of the guided lecture is to give students a flavor of how the public opinion surveys are set up and conducted. The survey methodology is one of the most technical parts of sociological knowledge. It entails a structured sequence of decisions and steps that are usually carried out by teams of researchers with a view of managing not only the process of data collection itself, but also: a) data validity (we measure what we want to measure); b) data reliability (we would arrive at similar results, if we were conducting the survey one more time). To deliver a lecture on methodological procedure of public opinion surveys may be challenging for a teacher with technical education.

It is likely that preparing for this session will require more time and attention than in the case of some other sessions. It is advisable to spent some time with the literature listed at the end of the chapter.

Besides comments concerning the concept of public opinion and the relevance of surveys for dealing with energy issues, the lecture concentrates on four key features, what is important to take notice of, when reading reports analyzing social data: a) delimitation of the target group; b) type of sampling; c) number of respondents; d) date of the data collection. In addition to it, some other methodological concepts are briefly sketched, such as representability of the sample to the target population, standardization of questions in the questionnaire or technological alterations of a questionnaire (with the help of a computer, telephone or web), data processing and analysis.

Activity 3:
Reporting and interpreting social data

Methods	Presentation
Keynotes	None
Materials	**TM3-ST1-RM2-report** **TM3-ST1-RM3-report** **TM3-ST1-RM4-report** **TM3-ST1-AM2-PP group work** **TM3-ST1-AM2-PP group work** **TM3-ST1-AM3-handout**
Required accessories	Computers operated by students, printed materials
Time allocation	30 min
Learning outcomes	Competency to read and assess reports presenting social data related to energy

This group work gives students an opportunity to practice data analysis and interpretation on concrete examples of survey reports. The teacher asks students to divide themselves in groups consisting of maximally 5 students. Each group will read and review a different short summary report from a survey, which is assigned to them by the teacher. The task is to read the report and agree in the group on: a) what are its main or most interesting findings; b) what is unclear or missing in the report; c) what they would do differently, when reporting the social data. Students have roughly 25-30 minutes time to complete the task using ready-made PP document template, which provides for the possibility of comparing the results among groups. While students in the groups go through the discussion, the teacher stays attentive and ready to assist them.

Activity 4:
Presentation of results & debriefing

Methods	Presentation, discussion
Keynotes	TM2-ST1-AM4-reading tips
Materials	**None**
Required accessories	Computer, projector
Time allocation	25 min
Learning outcomes	Competency to interpret and discuss social data

In the last activity, teacher asks representative(s) from each group to present in about 5 minutes the outcomes of the group task. While listening to these presentations, the teacher uses a board or flipchart to note down the main findings the given group arrived at. After each presentation, he or she may pose additional questions: What is the most important finding in the report? Why do you think it is so important? Do you find sufficient information concerning the data collection in the report, or is something missing? Does anything in the report seem strange to you? After all groups have finished, the teacher uses his or her notes to check, whether their presentations reflected sufficiently the pieces of knowledge delivered in the lecture and evaluates each group accordingly. At the very end, it is possible to sum up the main message of the session: Social data help us to understand and explain energy issues. We learned some basic practical rules for working with such data and we practiced them.

e) Additional resources

<table>
<tr><th>No.</th><th>Author and title</th><th>Description</th></tr>
<tr><td>1.</td><td>European Commission. 2015. Attitudes of citizens towards shale gas in selected european regions. Brussels. http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/yearFrom/1974/yearTo/2015/surveyKy/2066</td><td rowspan="2">Two examples of reports analyzing social data related to energy and comparing them among the EU member states. Eurobarometer surveys are the basic tool that the European Commission uses to gather information about the views that Europeans have on various subjects.</td></tr>
<tr><td>2.</td><td>European Commission. 2008. Attitudes toward Radioactive Waste Management. Brussels. http://ec.europa.eu/commfrontoffice/publicopinion/archives/ebs/ebs_297_en.pdf</td></tr>
</table>

Session 2:

Energy governance in the EU and its stakeholders

a) Session objectives

This session aims to familiarize the students with the framework on energy governance in the EU and explain the concept of energy stakeholder. Students will learn to perceive and analyze impacts of energy issues on stakeholders and will gain confidence in verbalizing and exchanging views on this matter.

b) Session scope

The second session is less about people's views and behavior and more about general political setup that generates conditions for people, collectivities or for any kind of actors to engage in many ways in energy related issues. The term 'energy governance' expresses this focus. Across the EU states to which the whole EduKit is targeted, energy governance takes place in a multilevel-framework of democratic institutions and is backed and regulated by legal systems. Some of the institutions and legal norms are more centralized and overarching. They are part of the evolving project of 'energy union' that is steered by the European Commission in order to tackle the challenges associated with energy transition. Other institutions and norms are rather national, regional or local and reflect the need for autonomy and diversity. Both sides of energy governance seem to be indispensable, but to strike a balance between them is a matter of continuous disputations and power games (Buchan 2009; Taulus 2016).

Energy governance and systems engineering

In some respect, the challenges of energy governance are comparable with the challenges of systems engineering. One of the options for the teacher is to compare these two terms, and exemplify the systems engineering e.g. on the technological issues of siting a major project, e.g. a large power plant. Even from the engineering point of view, it is hard to meet all different technical constraints (fuel transport, waste management, water supply, geological subsoil etc.) . On top of these issues there are societal challenges, including human resources, public acceptance, legal and economic constraints etc.

Technical students are surely to some extent aware of various phenomena linked with energy governance. On the other hand, this sphere is likely to remain rather hidden for them behind the technical staff they are themselves directly busied with. The first part of the session sketches some of the main features of energy governance framework in the EU and brings the attention of students to the diversity of actors engaged in energy issues. The vision of energy transition implies a huge task of gradual dismantling and rebuilding the bulk of outdated facilities and infrastructures. However, to set this whole process in motion will require considerable revisions of inherited strategies, policies and laws and designing of new ones at all levels of governance (European Commission 2017).

This is where the inclusion of the SSH point of view becomes crucial. **A multitude of actors is involved in endless negotiations about projects reshaping the energy future of Europe. These actors occur on all levels of the decision-making hierarchy; they have different interests and represent colliding values. It turns out that the deciding about energy is in fact a large-scale social process.** The second part of the session expands on this topic.

During the debates of recent decades, the concept of "(energy) stakeholders" has established itself as a key approach for grasping the variety of those, who feel involved in the processes of decision-making about energy, because they already are or will be impacted by the decisions taken. The range of the concept, however, is considerably broad. It may refer to: various governance bodies and state institutions; corporations and private companies; scientists, technicians and experts of many professions; nongovernmental organizations; municipalities; civic initiatives; communities of users; and of course, in the last instance, it refers to individuals and their households. Energy stakeholders perceive the current situation from different angels. While some of them see opportunities to profit from emerging new conditions, others fear that the change might have unwanted consequences for them.
In their group work, students will practice the energy stakeholder analysis. It is an umbrella term for diverse techniques that can be employed with a view on exploring and mapping the social or societal impacts of energy issues. The session shows energy stakeholder analysis as an area, in which technicians and energy experts can benefit from the expert knowledge provided by the social sciences and the humanities.

c) Pre-reading

No.	Author and title	Description
1.	Buchan, David. 2009. Energy and Climate Change. Europe at the Cross Roads. Oxford: Oxford University Press, pp. 1–27.	This book analyzes the energy governance in Europe from many viewpoints. The introductory passage of the book provides a useful overview of political principles and recent history of the EU energy governance.
2.	Taulus, Kim. 2016. Introduction to Energy Law. Oxford: Oxford University Press.	The first chapter of this book introduces into the principles of the EU energy governance from the juridical perspective.

No.	Author and title	Description
3.	European Commisssion. 2017. Third Report on the State of the Energy Union. Brussels. https://ec.europa.eu/commission/publications/third-report-state-energy-union_en	The EU is advancing towards its 2020 and 2030 energy and climate targets. This key EU policy document looks at the state of Energy Union as of the end of 2017.

d) Session activities

Activity 1:
European Energy Union

Methods	Presentation, discussion
Keynotes	None
Materials	**TM3-ST2-RM1-introductory video**
Required accessories	Computer with internet access, projector, speakers
Time allocation	15 min
Learning outcomes	Understanding of the project of Energy Union

Since the foundation of the European Steel and Coal Community in 1951, the European integration included collaboration on energy policy.

» *TODAY, WHEN ENERGY TRANSITION IS UNDERWAY TOGETHER WITH AN EFFORT PUT IN DECARBONISATION AND SHIFT TO A MORE ENVIRONMENTALLY FRIENDLY WAYS OF ENERGY PRODUCTION AND CONSUMPTION, THE IMPORTANCE OF ENERGY GOVERNANCE INCREASES.*

However, the EU consists of national states located in diverse geopolitical settings and with different types of economies. In this regards, it does not surprise that the agenda of energy governance is very complex and labyrinthine. The current session confines itself only to the elucidation of its basic principles.

Nowadays, the project of Energy Union represents the top level of energy governance in Europe. It was one of the flagships of the European Commission in the period from 2014. The initial video projection in the session explains this project and puts it into the context of the ongoing energy transition in Europe. The teacher frames the discussion about the video with questions such as: Is the project of energy union an adequate response to the challenge of energy transition in Europe? Will it be possible to put this political idea in practice? Is further integration in energy sector desirable? Will it work on national, regional and local level? The discussion should draw the attention of students to political and social scale of the project.

Feasibility, profitability and acceptability

The teacher should point out that it is by far not straightforward to find a consensus on an energy project. In the current society, the profitable options seem to be no longer acceptable due to environmental risks. Meanwhile, technology proposes feasible energy options that presently need a subsidizing policy. Students would be aware of the political consensus on subsidizing the renewable resources, but need not realize that many supporting technologies might make the existing policy more efficient – if subsidized. Possible examples, where consensus has not been found yet, cover energy storage into batteries or investments into underwater cables e.g. between Germany and Norway. Even in these cases, the dispute is not only economic, but also environmental.

Activity 2:

Group work

Methods	Lecture
Keynotes	None
Materials	**TM3-ST2-AM1-PP lecture**

Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of the energy governance framework in the EU, understanding of the concept of energy stakeholders.

The guided lecture delivers students some basic facts about energy governance in the EU. It summarizes the basic strands of the EU energy policy, briefly hints at the legal system of energy governance and mentions some of the most important energy policy institutions. To become familiar with this topic, it will be useful for the teacher, if he or she reviews the related literature listed in the resources collection before the session.

The concept of energy stakeholders bridges between the lecture and the following group work.

» *THE FRAMEWORK OF ENERGY GOVERNANCE DETERMINES RIGHTS AND DUTIES OF THOSE, WHO ARE INVOLVED IN THE ENERGY SECTOR.*

It creates conditions, under which individuals and collectivities (e.g. communities, institutions or corporations) decide about their actions and interact among each other. This takes place on international, national and local level and with respect to various stages of energy business, be it energy production, distribution and supply, consumption, or dismantling and waste management. Results of such interactions among various actors give rise to energy issues that may affect many people.

The concept of energy stakeholders will firstly be introduced by the teacher in this vast and general meaning encompassing all possible ways of how an energy project, facility or infrastructure may impact people's reasoning and lives.

Activity 3:
Dukovany nuclear power plant (case study)

Methods	Presentation
Keynotes	None
Materials	**TM3-ST2-AM2-PP case study** **TM3-ST2-AM3-handout**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Understanding of the energy governance framework in the EU, understanding of the concept of energy stakeholders.

Nevertheless, from the practical point of view, it is important for technical students to learn to recognize and analyze impacts on stakeholders in terms that are more concrete. Such an opportunity will be provided to them by the case study of Dukovany nuclear power plant, through which the general considerations on stakeholders will be narrowed down to one concrete empirical example. After the teacher uses PP presentation to provide basic information about the facility, he or she goes on with the group work.

Activity 4:
Energy stakeholders analysis

Methods	Group work
Keynotes	None
Materials	**TM3-ST2-AM4-PP group work**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Competence to analyze impacts of energy issues on stakeholders, competence to verbalize and exchange views about stakeholders.

The teacher asks students to divide themselves in two groups and distributes to each group a short summary of the presented case study with the facility situated on the map. Each group will fill in the ready-made PP document template referring to one of the two scenarios: a) no new reactors are constructed and the plant will be decommissioned; b) construction of reactor(s) will prolong the operation of the plant considerably (for another 30 – 50 years). The task of each group is to identify and describe for the given scenario: a) who are the stakeholders; b) positive impacts on stakeholders; c) challenges or negative impacts faced by stakeholders.
The teacher instructs students to leave the technical dimensions of the issue aside as much as possible and focus only on social or socio-economic impacts. He or she also encourages them to explore various impacts related to international, national and local level of governance. Students may search for information on-line during the exercise.

Activity 5: Presentation of results & debriefing

Methods	Presentation, discussion
Keynotes	TM3-ST2-AM5-reading tips
Materials	**None**
Required accessories	Computer, projector
Time allocation	25 min
Learning outcomes	Competence to analyze impacts of energy issues on stakeholders, competence to verbalize and exchange views about stakeholders

In the final part of the session, presentations of results of the group work reveal, how students understand the role of stakeholders: what stakeholders they identify, what impacts they perceive as the most or less important, how they weigh the three spatial dimensions of impacts comparatively (local and regional, national, international). The teacher provides students with feedback and stresses the case of Dukovany, albeit unique and linked with centralized nuclear energy sector, was outlined to illustrate features that may arise in many different types of energy projects as well. The message the session is supposed to convey to technical students is that it is possible to study impacts on stakeholders in systematic way and employ sociological research tools.

e) Additional resources

<table>
<tr><th>No.</th><th>Author and title</th><th>Description</th></tr>
<tr><td>1.</td><td>Frantál, Bohumil et al. Distance matters. Assessing socioeconomic impacts of the Dukovany nuclear power plant in the Czech Republic: Local perceptions and statistical evidence. “Moravian Geographical Reports” 2016, Vol. 25, Issue 1, pp. 2–13. DOI: 10.1515/mgr-2016-0001</td><td rowspan="2">Both journal articles analyze public perception and socioeconomic impacts. of the Dukovany nuclear power plant.</td></tr>
<tr><td>2.</td><td>Horská, Hana et al. 1996. Perception of the Dukovany Nuclear Power Plant (Czech Republic) by Local Population. “Moravian Geographical Reports” 1996, Vol. 4, Issue 2, pp. 19-34. http://www.geonika.cz/EN/research/ENMgr/MGR_1996_02.pdf</td></tr>
</table>

Session 3:
Communication among stakeholders and their participation in the decision-making

a) Session objectives

The goal is to understand the peculiarity of the processes of communication on energy issues and to learn to employ various practices for participation in decision-making. Students will gain competences to choose participative practices suitable for the given type of communication and to introduce measures to benefit local stakeholders. They will be ready to design comprehensive communication strategies.

b) Session scope

The third session approaches the topic of energy stakeholders in an even more practical vein. What energy experts are supposed to do, if there is already some existing energy project with widely perceived and discussed controversial impacts on stakeholders, or is such a project due for the near future? How they are supposed to cope with a situation, when representatives of various types of stakeholders protest or voice publically their disagreement with the project? When they mobilize resources for active resistance against it? As the democratic framework of the energy governance in the EU equips energy stakeholders with a number of rights, similar situations occur frequently, no matter, if the project in question is related to wind, solar, biogas, thermal, coal, nuclear or any other source of energy.

» *During implementation of energy projects, technicians and energy experts may easily face problems they have not been prepared for by their technical education.*

This matter is partially touched upon in other teaching modules, especially in the TM7 – Conflict Management and TM5 – Technology assessment as a tool for the society. SSH aspects covered in these modules are therefore left aside here. The session draws in particular upon the energy stakeholder analysis explained and practiced in session 2 and elaborates on it further. It conceives of

» *energy stakeholders as embedded in the web of socio-economic relations, which are subject to impacts produced by diverse implementation aspects of energy projects, facilities and infrastructures.*

This quite often gives rise to processes of opposition, defensive

Pro-active communication in technology

To prevent undesirable defensive communication, a pro-active communication of the plans before their implementation is required. Teachers are invited to ask students on their experience with pro-active communication. Many engineering students participated e.g. in science fairs where universities present their programs in order to find new juniors. Students should be able to conclude that pro-active communication is rewarding and important, however, at the same time, demanding on resources and its efficiency is difficult to evaluate. Teachers should mention that large power companies often outsource these ‘soft knowledge’ and rely on external Public Relation experts to advise on pro-active communication methods.

communication and action not intended strictly in technical implementation plans. Another bundle of potential problems is entailed by the fact that especially in more advanced stages of projects the implementation of specialized tasks is outsourced and yielded to subcontractors. Contracts based on non-transparent tenders or perceived by the public as expensive or unreasonable may undermine the reputation of the project and cast a shadow on the given energy technology.

The first part of the session familiarizes technical students with processes of communication developing around energy issues and thus makes them more receptive and capable to anticipate possible disruptive effects these processes might have on time and cost efficiency of technical solutions. The session draws upon the concept of *participative democracy* outlined in a more theoretical vein in the module Ethics and philosophy of energy development as a complement to the procedures of representative democracy. This time, however, the lesson treats participative democracy rather as an *array of practices* that it is possible to employ in the decision-making about technical projects, facilities and infrastructures with view of making their technical design more socially acceptable. This is also the view of participative democracy endorsed by the framework of energy governance in the EU. The session also explains basic types of *measures to benefit stakeholders.*

c) Pre-reading

No.	Author and title	Description
1.	Callon, Michel et al. 2009. Acting in an Uncertain World. Cambridge – London: The MIT Press, pp. 153–190.	Chapter 6 of the book describes several important practices of participation in the decision-making. It focuses especially on organization of “hybrid fora”, which enable the communication between experts and lay public.
2.	OECD, Nuclear Energy Agency. 2013. Stakeholder Confidence in Radioactive Waste Management. An Annotated Glossary of Key Terms. https://www.oecd-nea.org/rwm/docs/2013/6988-fsc-glossary.pdf	The document explains SSH concepts used in debates on the nuclear waste management.

No.	Author and title	Description
3.	Kåberger, Tomas, Johan Swahn. 2015. Model or Muddle? Governance and Management of Radioactive Waste in Sweden. In: Mez, Lutz, Achim Brunnengräber (eds.). Nuclear Waste Governance. Wiesbaden: Springer, pp. 203-226.	This text updates on the Swedish approach to the siting of the deep geological repository.

d) Class activities

Activity 1:

Decision-making about the deep geological repository of nuclear waste in Europe

Methods	Presentation, lecture, exercise
Keynotes	None
Materials	**TM3-ST3-RM1-introductory video** **TM3-ST3-AM1-PP lecture**
Required accessories	Computer, projector, speakers, flipchart (board), markers
Time allocation	40 min

Learning outcomes	Understanding of the impact of energy projects on social relations, understanding of the implementation aspects of energy projects from the SSH point of view

The session commences with a broader elucidation of the problem associated with the disposal of the most dangerous nuclear waste in Europe (spent nuclear fuel, high-level waste, not intermediate and low-level waste). The teacher presents the matter to students as an extreme and historically unprecedented case, in which, owing to its complexity, almost all problems and questions related to communication and participation in decision-making arise that energy experts and technicians may face in other, less complex cases as well. It is also a case to which a broad international attention is paid and which concerns every European country using nuclear energy.

The teacher should be clear about the technical concept of the deep geological repository as the globally preferred solution for disposing of the nuclear waste. It is the precondition for presentation of the matter from the SSH viewpoint. To secure that students also have basic technical information about the concept, the teacher plays one of the listed informatory videos about the repository. It is important to stress the key geological criterion for the repository site selection (mostly the granite massif is preferred).
The following explanation of the matter is based on a short power point presentation framing the whole issue from the SSH viewpoint. On one hand, the solution of the problem with nuclear waste is being sought on an international level. As the construction of a joint international deep geological repository appears to be politically unpassable, the top European legislature obliges the EU member states to pursue in timely and legally correct manner the way to the siting, construction and operation of their own national deep geological repositories.

On the other hand, the issue assumes local meaning in the last instance, because some local community has to accept the project of the repository in its vicinity. As nobody in general jubilates at realizing the nuclear waste might find its final rest under his or her home, to secure such an acceptance in any local community becomes extremely challenging. Local communities considered for the siting of the repository are usually scared. Not only due to the possible risk of (invisible) radiation, but also due to the change it would entail for the current social or socio-economic relations, which are embedded in certain history, traditions and ways of living often not connected with nuclear energy.

Only a few states have so far managed to negotiate or to come close to negotiating the site for their national repository: especially Finland, where the repository is already under construction, and in Sweden, where the national radioactive waste company is close to getting permission for building it. Experts often regard the Swedish project as the most successful in terms of communication with public. It is advisable for the teacher to focus on it during the pre-class reading.

After depicting the issue of the deep geological repository in Europe, the teacher guides students to the exploration of various implementation aspects that are nontechnical in their nature and call for the incorporation of the SSH expert knowledge. Teacher starts the exercise by posing questions about the social dimension of the repository:
What does it mean in concrete that the project of geological repository is irreducible to technical issues? Try to name those implementation aspects of the project, which may require assistance of nontechnical sciences. Try to name all such implementation aspects that occur to you. Alternatively, try to describe some social phenomena that this project is likely to trigger and which the technicians alone can hardly sort out.
The teacher writes the answers of students on the board or on the flipchart. Once the discussion seems to be over, the teacher provides feedback to students by presenting the summary slide distinguishing 9 various implementation aspects of the repository that point to the social dimension (communicative, political, legal, economic, ethical, safety, environmental, construction-related, and cultural). Teacher takes his or her time to expand a little bit on the specificity of various implementation aspects.

The teacher opens up the discussion with stimulating questions such as: Have you ever come across ethical problems related to energy? Even if it is not the case, can you fancy such problems, when you think about ethics? If you take into account various energy resources and compare them, which of them are more likely to arouse ethical considerations? Can you explain why or in what sense? The discussion serves as the first exploration of the topic. The teacher may record the findings of the discussion on the board or flipchart, comment on them or even return to them during the later interactive exercise.

Activity 2:
Typology of stakeholders and their communication

Methods	Lecture
Keynotes	None
Materials	**TM3-ST3-AM2-PP lecture**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Understanding of processes of communication on energy issues

Teacher takes the case of the deep geological repository as the starting point for the second activity as well. The lecture first describes various types of stakeholders involved in the decision-making about the repository. Compared to other energy issues, which are often more local or regional in its scope (e.g. building of a wind or solar park), the national projects of the deep geological repository are commonly dependent on decisions made by the top state executive and legislative bodies (the Government, the Parliament).

» *Projects of repositories are deemed momentous for the society as a whole, because they concern the responsibility for the produced nuclear waste shared by the given population.*

In this respect, they represent comparable or even more consequential societal commitment as e.g. the decisions about the building of nuclear power plants.

The illustration supplied by the case of the deep geological repository provides material, on the basis of which four circles of communication about energy issues are distinguished:

a) Communication within the state administration;
b) Communication in local community;
c) Communication between the state administration and local community;
d) Communication with the general public. Teacher uses four circles to explain the communication about energy issues in general; no matter what particular energy resource is the subject of communication in the given case.

The problem of finding a common language

Experts often use a specialized style of communication (expert terms, abbreviations etc.) and struggle to find a common language with the lay public. Students should assess their own personal skills, interests and responsibilities realistically. Not every high-level expert is sufficiently talented and/or prepared for communication with the general public. A project manager need not be an excellent communicator, but needs to understand the importance of excellent communicators.

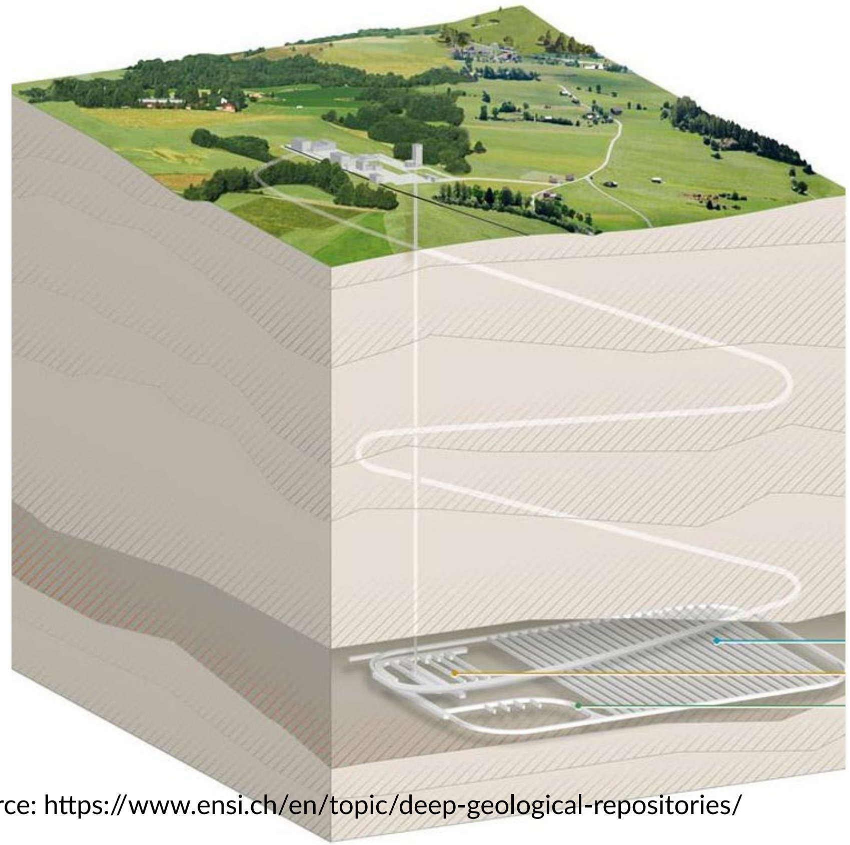


Image source: https://www.ensi.ch/en/topic/deep-geological-repositories/

Activity 3:
Practices for participation in the decision making

Methods	Exercise
Keynotes	None
Materials	**TM3-ST3-AM3-PP exercise** **TM3-ST3-AM4-handout**
Required accessories	Computer, projector, printed handouts
Time allocation	30 min
Learning outcomes	Understanding of practices for participation in the decision-making.

Communication about energy issues means one-sided provision of information in the first place. Implementation of energy policies commits the responsible institutions (mostly the state ones) to inform continually the public about the development. To act transparently and in accordance with law is vitally important for these institutions, if they are to retain trust of the people. However, the execution of power inevitably entails that many important communications within the state administration occur behind the closed door. The provision of information about these communications to the public than becomes rather a matter of political culture or good will of concrete politicians.

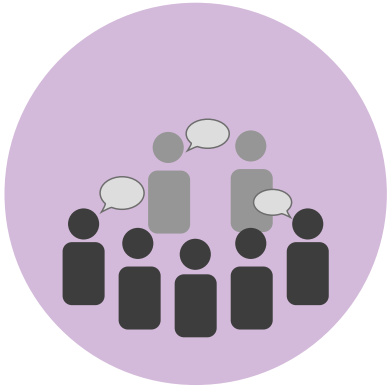
» *On the other hand, making of decisions about energy issues in general involves communication among a multitude of actors, what necessitates discussion, negotiations and participation of stakeholders in the decision-making process.*

In the third activity, the teacher familiarizes the students with various good practices that are suitable for ensuring of such participation. Each practice is presented on a separate PP slide and the teacher asks students, to what circle of communication they would assign it and why. The teacher immediately provides feedback regarding the correctness of each assignment. After the explanation of all practices is complete, the teacher presents the overview of all practices and gives students the handout with this overview.

Overview of practices for participation in the decision-making and their assignment to the four circles of communication:

Communication within the state administration

It is subject to the general claim on transparency and legal accurateness. It is governed by the rules of representative democracy, administrative routines and political culture.



Communication in local community

Available practices: local public debate, focus group, civic committee (panel), community association (local working group).

Communication between the state administration and local community

Available practices: round table, national working group.

Communication with the general public

Available practices: environmental impact assessment (EIA), online forum, public hearing (e.g. in the Parliament), consensus conference, national public debate.

Activity 4:
Overview of measures to benefit local stakeholders

Methods	Lecture
Keynotes	None

Materials	**TM3-ST3-AM5-PP lecture**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Preparation for the next session

At the end of the first part of the session, the teacher uses PP presentation to familiarize the students also with four types of measures to benefit local stakeholders: mitigation, compensation, incentives and guarantees.

Activity 5:

Strategy for communication and participation in the decision-making

Methods	Presentation, project
Keynotes	None
Materials	**TM3-ST3-AM6-PP project** **TM3-ST3-AM7-handout**
Required accessories	Computers operated by students
Time allocation	60 min
Learning outcomes	Understanding of practices for participation in the decision-making

After the break, teacher agrees with students on their division into groups (at least two students in each group) and students are get ready for elaboration of their own strategy for communication and participation in the decision-making process. The teacher uses PP presentation to relate the outcomes of the first part of the session to this project exercise.

Energy projects usually embrace various practices for participation in the decision-making and measures to benefit local stakeholders with view of facilitating the adoption of the given project by locals and its inclusion into the local community planning. Energy projects, when accepted by the community, cease to be perceived as foreign technocratic interventions. The introduction of energy technologies may, on the contrary, result in local economic growth and, even more importantly, may enrich and transform the cultural identity of the community and its ways of living. To be sure, not every energy project succeeds. In many cases, the local opposition is strong and obstinate. In other cases, uncontrolled vested interests and lobbyism may impair the project. It should be highlighted by the teacher that the practices or participative democracy help to tackle these phenomena and thus underpin the legitimacy of the resulting solution.

The teacher assigns each group a different fictive problem situation linked with the siting of an energy facility. A brief summary text describes the given problem situation, but is schematic enough to allow teacher to frame the situation further (e.g. in relation to the national or regional context known to students), if he or she wishes to. Three descriptions of problem situations are available: siting of a larger wind farm, introduction of a smart grid technology to the municipality and construction of a new reactor in an existing nuclear power plant. The aim of the project is to develop a complex strategy for communication and participation in the decision-making, which will cover the following areas:

a) Identification of the most important stakeholders;
b) Outline of the approach to the communication with stakeholders;
c) Introduction of practices for participation in the decision-making;
d) Introduction of measures to benefit local stakeholders;
e) Tips for empowering of the local community planning.

Each group fills in the ready-made PP document template. Students may search for information on the internet. They have roughly 50 minutes to complete their project.

Activity 6:

Presentation of results & debriefing

Methods	Lecture
Keynotes	None
Materials	**TM3-ST3-AM8-reading tips**
Required accessories	Computer, projector
Time allocation	30 min
Learning outcomes	Preparation for the next session

After the exercise, representative(s) of each group present the project. Students from other group(s) may react, ask questions and exchange their views. The teacher moderates the interaction, checks up to what extent the projects employ the knowledge presented in the first part of the sessions and provides final feedback to students. The teacher stresses that the success of any strategy is conditional to an ongoing communication and negotiations with stakeholders. The existence of whatsoever perfect strategy document will alone never do the job.

e) Additional resources

No.	Author and title	Description
1.	Durdovic, Martin. 2016. A Guide to Communication and Participation in Decision-Making on Siting a Deep Geological Repository. The Case of the Czech Republic. Prague: Institute of Sociology of the Czech Academy of Sciences. http://www.soc.cas.cz/en/node/4910	Document explains the topic of the session on the case of siting of the repository in the Czech Republic.
2.	Fairley, Peter. 2017. The complex web behind the siting of power plants. "Nature" 2017, Vol. 551, pp. 150-152. https://www.nature.com/articles/d41586-017-07511-2	Article presenting up-to date view of

Assessment methods and final assignment

Assessment of the collective work

During the sessions, students complete their main tasks in groups (up to 5 students in each group). In each session, teacher assesses the performance of the group. Individual students get the same percentage score as their group fellows. Groups do not change; each student remains a member of one group in all sessions. The teacher uses the following assessment tables and issues a separate table to each group for its activity in the given session.

SESSION 1: REPORTING AND INTERPRETING SOCIAL DATA

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Correct usage of survey methodology principles							Total score
Accuracy of data interpretation							
Ability to grasp the main findings							
Ability to see the weak points							

SESSION 2: ENERGY STAKEHOLDERS ANALYSIS

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Identification of stakeholders							Total score
Exploration of negative impacts							
Exploration of positive impacts							
Ability to grasp the social dimension							

SESSION 3: STRATEGY FOR COMMUNICATION AND PARTICIPATION IN THE DECISION-MAKING

Aspects of the group performance	Score	25%	20%	15%	10%	5%	
Approach to the communication with stakeholders							Total score
Introduction of participative practices							
Introduction of measures to benefit stakeholders							
Empowering of the local community planning							

Grading – one session:
100 % - 90 % = A
89 % - 75 % = B
74 % - 60 % = C
59 % - 50 % = D
49 % - 40 % = E
Lower than 39 % = F
In case that more than one session is taught, teacher uses the average score to determine the final grade.

Assessment of the individual work

If the teacher wants to assess students individually as well, he or she may ask them to write an essay. Writing of an essay will help students to expand their knowledge and focus on a special topic. Teacher employs the same grading scheme and can use the average of the collective and the individual score to determine the final grade.
Some suggestions of an essay topic:

- *interpretation of a selected Eurobarometer survey report related to energy issues;*
- *reflection on the viability of the EU energy governance framework with respect to the national conditions and/or with respect to a particular source of electricity production;*
- *reflection on the role of participative democracy in the decision-making about energy projects.*

Attachment: Syllabus

1. Name of the Teaching Module

Energy and the public.

2. Brief description of the subject matter

Energy policies, projects and facilities often attract attention, spark public debates and provoke protests. Even though they may have direct impact only on a particular population or social group, some of their aspects often concern larger society as a whole. The quantitative distribution of views on energy issues can be studied with the help of public opinion surveys and the social data they produce.
The energy governance in Europe takes place in a multi-level political framework of democratic institutions. Groups of people affected by decisions about energy can organize to make their voice being heard. Social sciences provide useful background for understanding of how such "stakeholders" emerge and what is their impact on the process of governance. And they also offer a variety of good practices that help to prevent or mitigate conflicts among stakeholders. These practices concern organization of communication among stakeholders, enhancements of their participation in the decision-making, introduction of measures to benefit stakeholders or issues associated with local community planning. As the case studies from the field of nuclear energy illustrate, to reach social acceptability can be very challenging.

3. Complete SSH problems description

- The concept of public opinion, its measurement and relation to energy issues; key features of public opinion surveys methodology; interpretation of social data from public opinion surveys.
- Democratic framework of the decision-making about energy in the EU; stakeholders – their definition, emergence, typology and role in the decision-making.
- Organization of communication among stakeholders and their participation in decision-making; participative practices; measures to benefit stakeholders, local community planning.

4. Prerequisites

There are no prerequisites except the interest for the theme. The module is intended for master and PhD students. However, also bachelor students may attend.

5. Learning outcomes

a) Knowledge
Students will learn the basics of public opinion surveys methodology. They will acquire general knowledge of the energy governance framework in Europe and its stakeholders. They will familiarize with approaches to organization of communication among stakeholders and their participation in the decision-making.

b) Skills
Students will gain self-confidence in analysis and evaluation of social data related to energy. They will become responsive to various impacts that energy projects may have on stakeholders and local communities. And they will be able to assess and design various practises of stakeholders' engagement.

c) Social competencies
Group work and project work in all sessions will teach students to perceive social impacts of energy issues, to verbalize their observations, to exchange their views and defend arguments.

6. Form of classes

- The module consists of three interlinked sessions. First two are designed for 90 minutes long session each, the third one for 180 minutes.
- To explore thoroughly the area of energy and the public, it is recommended that the stages follow one after another connectedly or in three single days. However, each stage is optional and it is also possible to select only one separate stage without going through the others.
- Sessions combine lectures and presentations of materials with interactive elements and with group and project work..
- Each session is accompanied with pre-readings, which help teacher to prepare for the class. Pre- readings may also be suitable and useful for students attending the class. Teacher may assign students to read some of them before the class. Additional references to specialized literature and other sources give both teacher and students hints for expanding their knowledge in particular fields of

interest.

- Optimal number of students is from 6 to 15 in the class.

7. Teaching methods

- Lecture
- Presentation
- Discussion
- Exercise
- Group work
- Project

8. Detailed classes plan

Stage 1: Public opinion on energy issues in a nutshell
Contents:

- public opinion surveys / polls as a source of social data,
- their application in relation to energy issues,
- key features of public opinion measurement,
- selected methodological features,
- how to read reports from public opinion surveys.

Stage 2: Energy governance in the EU and its stakeholders
Contents:

- energy governance in the EU and the project of “energy union”,
- international, national, regional, local level,
- definition and role of stakeholders,
- impact of energy policies and project on stakeholders,

- potential tensions and conflicts.

Stage 3: Communication among stakeholders and their participation in the decision-making
Contents:

- energy and participative democracy,
- process of communication about energy issues ,
- practices for participation of stakeholders in the decision-making,
- measures to benefit the local community,
- questions associated with local community planning.

Required materials & equipment

- Power Point presentation,
- computer, projector,
- flipchart or board,
- internet connection.

9.Literature and other materials

1. Public opinion on energy issues in a nutshell

1.1. European Commission. 2017. Climate Change. Brussels. http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/yearFrom/1974/yearTo/2018/surveyKy/2140
1.2. European Commission. 2018. SMEs, resource efficiency and green markets. Brussels. http://ec.europa.eu/commfrontoffice/publicopinion/index.cfm/Survey/getSurveyDetail/yearFrom/1974/yearTo/2018/surveyKy/2151

2. Energy governance in the EU and its stakeholders

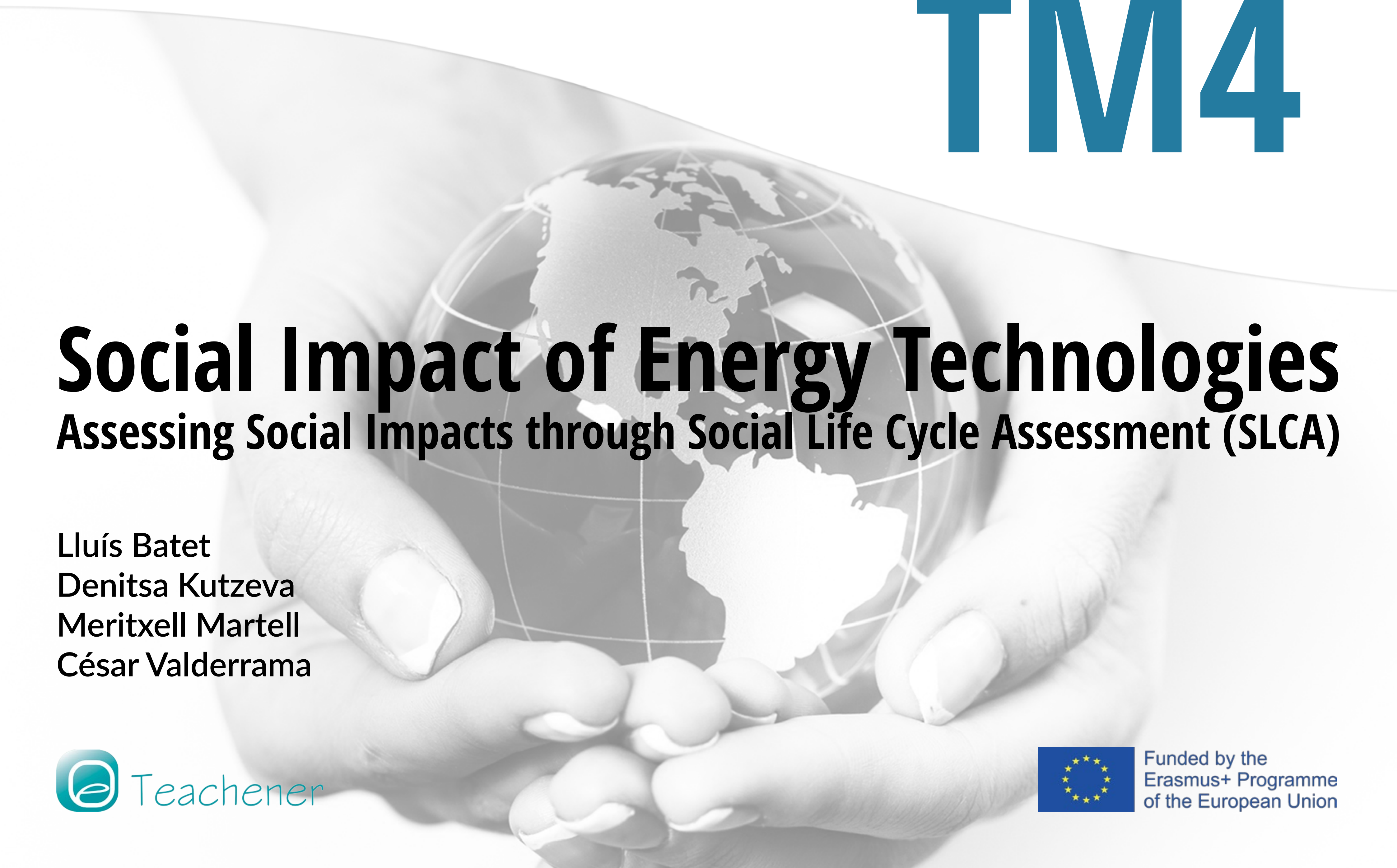
2.1. Leal-Arcas, Rafael, Jan Wouters. 2017. Research Handbook on EU Energy Law and Policy. Cheltenham – Northampton: Edward Elgar Publishing.

2.2. Martell, Meritxell, Gianluca Ferraro. 2014. Radioactive Waste Management Stakeholders Map in the European Union. European Commission: Joint Research Centre.
https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/radioactive-waste-management-stakeholders-map-european-union-report-may-2014
2.3. Müller, Wolfgang, Paul W. Thurner. 2017. The Politics of Nuclear Energy in Western Europe. Oxford: Oxford University Press.

3. Communication among stakeholders and their participation in the decision-making:

3.1. Andersson, Kjell. 2008. Transparency and Accountability in Science and Politics. New York: Palgrave Macmillan.

TM4



Social Impact of Energy Technologies

Assessing Social Impacts through Social Life Cycle Assessment (SLCA)

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Teachener

Funded by the Erasmus+ Programme of the European Union

Introduction

The main goal of this module is to introduce the Social Life Cycle Assessment (SLCA) methodology to the students and make them aware of the importance of the social criteria by assessment of the local and global social impact related to energy projects.

» *The increasing demand for energy has been one of the most significant factors in the acceleration of global warming. It has required developing strategies on the local and global levels to enhance energy security and sustainability through innovative energy policies and measures.*

The need for building further effective ways to navigate the future with practical and sustainable solutions has initiated the developments of sustainability measurement tools, such as Life Cycle Assessment (LCA). The role of LCA is to assess the environmental impact of processes/systems/products associated with all stages of their life-cycle perspective. Life Cycle Assessment (LCA) was developed over the last years as a tool enabling the identification and assessment of the environmental impacts associated with a product, process, or activity by quantifying raw materials, energy and waste it releases into the air, water and soil. For instance, in the case of Industrial Minerals, LCA covers the extraction, processing, manufacturing, distribution, use and disposal steps, including transportation, along the entire supply chain (i.e. upstream and downstream).

As a step further, social criteria may also be included in the sustainability assessment analysis, through a tool inspired on the LCA: the Social Life-Cycle Assessment (SLCA).

» *SLCA is a tool that analyses the impact on society of products or services throughout their life-cycle, assessing the actual and potential positive and negative impacts.*

Research on standardization of a methodology for conducting SLCA is limited compared to LCA but it is still ongoing.

This module aims to introduce the SLCA methodology as a tool to measure the main social impacts of energy projects through a life cycle perspective. Through it, students will be able to grab the importance of SLCA and contextualize this methodology; students will learn the steps needed to design and conduct an SLCA and will glimpse the difficulties in defining suitable sustainability indicators in what regards social aspects and in obtaining values for those indicators.

Social indicators are currently being considered for energy projects, along with the technical, economic and environmental aspects. However, the overall social impact on a local and global scale is hardly addressed by most currently used methods for social evaluation in the energy field. That is why this TM focuses on SLCA.

The teaching module is composed of 2 successive sessions:

1

Session 1: Introduction to SLCA
consists mainly of an introductory lecture to present the context framing SLCA. A specific discussion is planned on indicators, their role in the sustainability science, their desirable characteristics and how to choose them. Finally, the first session will introduce the case study that will be the basis of the work to be developed by students grouped in teams during the second session.

90 minutes

2

Session 2: SLCA practical application
is devoted to developing an SLCA based on the case study introduced at the end of the first session. Students are grouped in teams of ideally four or five people. Teams of students are randomly formed (alternatively, the teacher decides who will be the members of each group) at the end of the first session. Each member is involved in developing a presentation between the two sessions based on the information provided on the case study. One of the teams is randomly chosen (or decided by the teacher) to present the case study at the beginning of the second session. Once the case study is presented in class, teams start working on the analysis step by step with the guidance of the teacher. The aim of the learning method is to ensure the interaction among students in order to develop a comprehensive assessment.

135 minutes

Session 1:

Introduction to Social Life Cycle Assessment (SLCA)

a) Session objectives

This session intends to provide the students with a basic understanding of Social Life Cycle Assessment (SLCA), framing it within the Sustainability Assessment tools and, more precisely, within the Social Assessment tools. The session will raise students' awareness of tools needed and of the complexity of this kind of assessments, with a focus on the difficulties of developing a suitable set of indicators. Students are introduced to Life Cycle Assessment methods as a necessary step to comprehend the SLCA methodology.

b) Session scope

Sustainability Assessment

From a broad perspective, Bond et al. (2012) define Sustainability Assessment as "any process that directs decision-making towards sustainability". Waas et al. (2014) define it as "any process that aims to:

- Contribute to a better understanding of the sustainability and its contextual interpretation (interpretation challenge);
- Integrate sustainability issues into decision-making by identifying and assessing sustainability impacts (information-structuring challenge);
- Foster sustainable development policies (influence challenge)."

The three challenges refer to the relationship between sustainability and decision making: sustainability is to be interpreted in a given context, sustainability's complexity requires of an adequate organization and communication of the information (e.g. by means of indicators), and that information should influence decision making (Waas et al. 2014).

Ness et al. (2007) proposed a framework for the sustainability assessment tools based on the temporal characteristics of the tool along with the object of its focus and its capacity of integrating nature-society systems. As for the temporal dimension, tools can be either retrospective (indicators and indices), prospective (integrated assessment tools) or both (product-related assessment tools). The object of focus can be a proposed change in policy in a given area (indicators/indices and integrated assessment), or at the product level (product-related assessment). Finally, some of the tools are able to integrate nature-society systems in a single evaluation (e.g. Human Development Index).

The indicators/indices provide information, from a retrospective point of view, about long-term sustainability trends; information that may allow short-term projections and decision making for the future.

» *INTEGRATED ASSESSMENT TOOLS ARE USED FOR SUPPORTING DECISIONS RELATED TO A POLICY OR A PROJECT IN A SPECIFIC REGION; THEY HAVE AN EX-ANTE FOCUS AND NORMALLY ARE PERFORMED THROUGH SCENARIOS.*

Many of these integrated assessment tools integrate nature and society aspects. They are divided into three sub-categories (Dizdaroglu 2007): M**ulti-Criteria Analysis**, to compare policy options; **Cost Benefit Analysis**; and **Impact Assessment** tools.

Finally, product-related assessment tools focus on the resource use and environmental impacts of a product or service from a life cycle perspective, allowing both retrospective and prospective assessments.

Introduction to Life Cycle Assessment

Life Cycle Assessment (LCA) is the most developed of the product-related assessment tools. It aims to quantify the environmental impact of a product, a process or a service, from "Cradle to Grave". For each of the stages considered, LCA accounts for all consumed resources and all emissions in the environment. A typical LCA takes into account several thousands of substances emitted into air, water and soil. Then, this substance inventory is translated into different environmental impacts (carbon footprint, water footprint, energy consumption, acidification, resource depletion, etc.). ISO standards 14040 and 14044 provide a standardized methodology for conducting multi-media, life-cycle environmental assessments (EPLCA web site):

- ISO 14040 "Life Cycle Assessment – Principles and Framework" 1997
- ISO 14044 "Life Cycle Assessment – Requirements and Guidelines" 2006

There are 4 main steps to be considered while conducting an LCA:
Goal and scope definition: in this step the methodology to be follow

1

Goal and scope definition

in this step the methodology to be followed in the subsequent analysis is defined along with the boundaries of the system to be analysed. In this phase, the type of report is selected as well

2

Life Cycle Inventory (LCI)

this step involves compiling as much input (raw materials, energy, water, etc.) and output (products and co-products, water effluents, airborne emissions, solid waste, etc.) data as possible.

3

Life Cycle Impact Assessment (LCIA)

in this step, the potential environmental impacts are quantified from the data collected in the previous step:
- inputs and outputs are assigned to impact categories (classification)
- characterization models are selected by means of which input and output data are converted into potential impacts (characterization)

4

Life cycle interpretation

in this last step major issues are identified and conclusions are reported, including recommendations and a reflection on the quality of the assessment.

Social Assessment Methods. Social Life Cycle Assessment (SLCA)

Sustainable Development can be thought of as having three dimensions: environmental, economic and social. Social aspects can be assessed through a variety of tools, either as part of the sustainability assessment or as specific assessments. One of these tools is Social Life Cycle Assessment (SLCA).

» *The Inclusion of social themes in the life cycle analysis allows to express a preference for products that are more social-friendly and to identify potential improvements in the processes and supply chain.*

The life cycle perspective provides SLCA (among other social impact assessment methodologies) with an overarching vision of the social impacts.

In any case, the assessment allows to compare different alternatives in order to identify the best one of them and, this way, support policymaking.
Moreover, there is a growing public sensitivity of social aspects and, so, an interest in identifying social hotspots.

> *"Social hotspots are unit processes located in a region where a situation occurs that may be considered a problem, a risk or an opportunity, in relation to a social theme of interest. The social theme of interest represents issues that are considered to be threatening social well-being or that may contribute to its further development.*
> *Social themes of interest include but are not restricted to: human rights, work conditions, cultural heritage, poverty, disease, political conflict, indigenous rights, etc." (UNEP/SETAC 2009)*

SLCA methodology is still being developed: guidelines need further development and more case studies are required. Other limitations of the SLCA methodology are:

- It is quite subjective and allows much freedom of choice to the researcher.
- Some important social themes can only be measured qualitatively.
- In any case, indicators for social themes need to be defined.

Social Life Cycle Assessment Methodology

Social Life Cycle Assessment (SLCA) aims to assess the social and socio-economic aspects of products and services and their potential positive and negative impacts along their life cycle (supply chain, including the use phase and disposal). SLCA methodology is based on the LCA methodology introduced above and follows as well the ISO 14044 framework. The four major phases of the methodology (goal and scope, inventory analysis, impact assessment, and interpretation) will be briefly introduced next. For a Historical development of SLCA, from the end of the 20th Century, see the introduction to the chapter written by E. Rosenbaum in Sala et al. (2015).

The Guidelines for Social Life Cycle of Products (UNEP/SETAC 2009) provide tools for social impacts assessment in relation to an area of protection, such as human well-being. They suggest five stakeholder categories: workers, local community, society, consumers and value chain actors. Every stakeholder category is associated with a number of impact subcategories, such as child labour, fair salary, health and safety, local employment, cultural heritage and corruption, human rights, working conditions, governance and socioeconomic repercussions. The Methodological Sheets for Subcategories in Social Life Cycle Assessment (UNEP/SETAC 2013) provide a framework for every different stakeholder including subcategories' definition, policy relevance, directions on how to assess data and examples of indicators.

Goal and Scope. As a starting point of a Social Life Cycle Assessment, the purpose of it must be set: "Why is an S-LCA being conducted? What is the intended use? Who will use the results? What do we want to assess?" (UNEP/SETAC 2009).

The scope comes next: what are the depth and breadth of the study? The scope defines the boundaries of the study and the amount and quality of data to be collected and processed.

To define the scope, an ideal system should first be defined (i.e., an accurate definition of the complex network of the existing interrelations between the different parts of the system), and then a model of the actual system should be built (purposely simplified, to make it suitable for assessment). Finally, it should be decided which processes should be characterized by specific (local) data and which ones by generic data. The definition of the scope may have a large impact on the results of the analysis.

Life Cycle Inventory analysis consists mainly of collecting data for: 1) prioritization, 2) hotspots assessment (see above for a definition of the hotspot), 3) site specific evaluation and 4) impact assessment (characterization). Data needs to be validated. After gathering the information, some refinement or redefinition of the system boundaries is needed.

Life Cycle Impact Assessment consists mainly of classifying, aggregating and characterizing the data according to performance reference points (i.e., indicators are constructed) for the different impact categories selected. One of the issues that are more complex in the development of a Social Life Cycle Assessment (SLCA) framework is the choice of social indicators.

Impact Categories "represent social issues of interest that will be expressed regarding the stakeholders affected and may cover health and safety, human rights, working conditions, socio-economic repercussions, cultural heritage and governance." (UNEP/SETAC 2009)

Subcategories are significant social themes which can be classified according to the impact categories but are more practically grouped according to the stakeholder categories. Subcategories are assessed by means of indicators (see Figure 1 and Table 1)

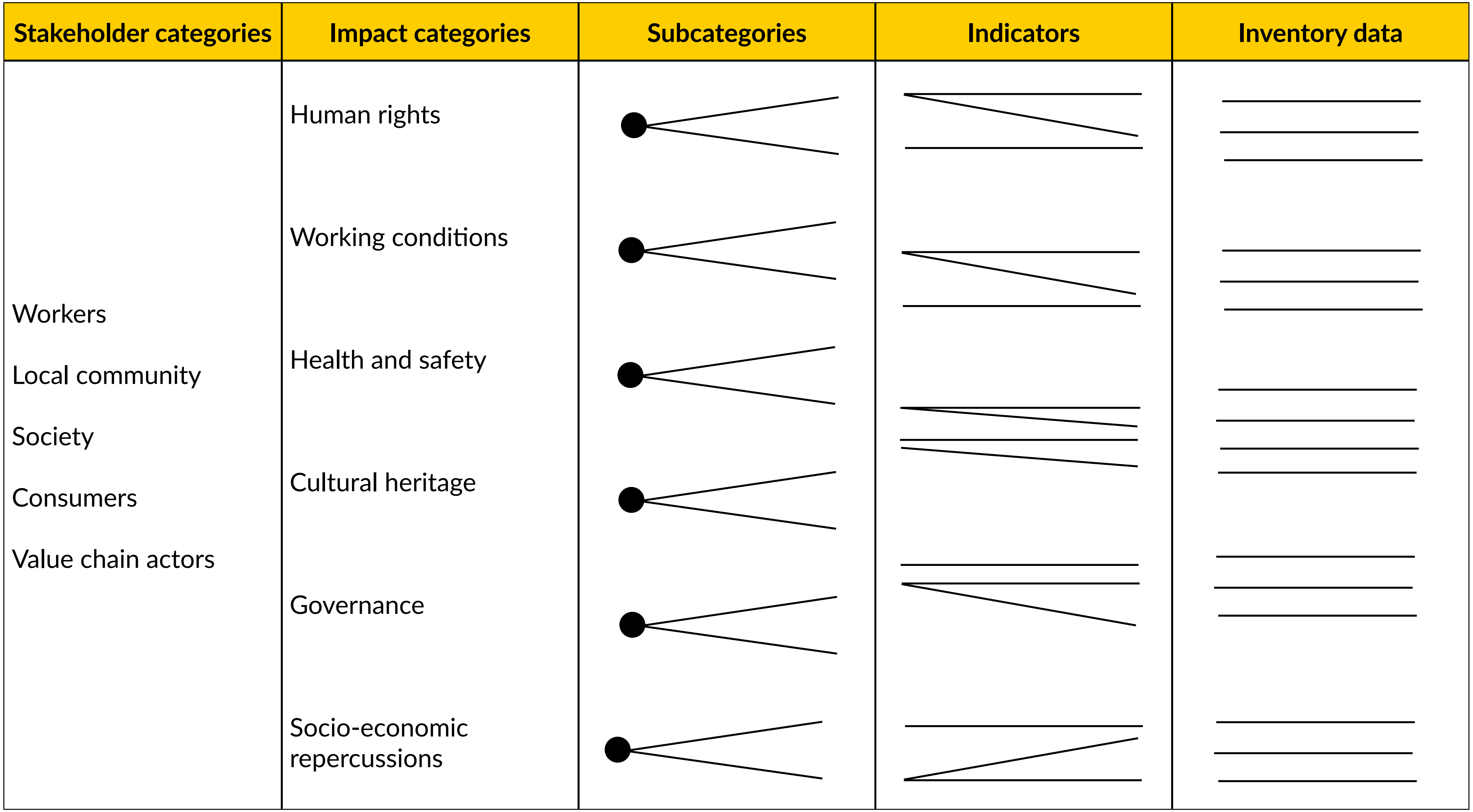


Figure 1. SLCA assessment system adapted from UNEP/SETAC (2009)

Stakeholder categories	Subcategories
Workers	• Freedom of Association and Collective Bargaining • Child Labour • Fair Salary • Working Hours • Forced Labour • Equal opportunities/Discrimination • Health and Safety • Social Benefits/Social Security
Consumers	• Health & Safety • Feedback Mechanism • Consumer Privacy • Transparency • End of life responsibility
Local community	• Access to material resources • Access to immaterial resources • Delocalization and Migration • Cultural Heritage • Safe & healthy living conditions • Respect for indigenous rights • Community engagement • Local employment • Secure living conditions

Society	• Public commitments to sustainability issues • Contribution to economic development • Prevention & mitigation of armed conflicts • Technology development • Corruption
Value chain actors	• Fair competition • Promoting social responsibility • Supplier relationships • Respect for intellectual property rights

Table 1. Stakeholder categories and subcategories (UNEP/SETAC 2009)

Life Cycle interpretation has the following objectives: assess the results in order to obtain conclusions, explains the limitations of the analysis, provides recommendations and report adequately. One relevant aspect to consider in the report is the involvement of the stakeholders (UNEP/SETAC 2009).

EXAMPLE OF APPLICATION OF SLCA

SLCA of palm oil biodiesel: a case study in Jambi Province of Indonesia (Manik et al. 2013).

The goal of the study is to assess the social implications of an existing palm oil production system. The following specific questions are answered:

- *What are appropriate social criteria that should be used to assess the sustainability of biofuels, particularly palm oil biodiesel life cycle?*
- *How do stakeholders appraise the achievement of those criteria based on their own experience in the selected case?*
- *What are the social sustainability hotspots within palm oil biodiesel that need further research and policy?*

The scope of the study covers all stages of palm oil biodiesel supply chain that exist in the area, which includes the land clearing, palm plantation, palm oil milling, and transportation of crude palm oil from the mill to a seaport. Hence, the biodiesel conversion process in the importing countries is excluded from this study. The case study follows the UNEP/SETAC methodology.

A panel of experts provided weighting factors for the criteria within the categories. After that, a series of questions were asked to the 120 participants in a survey, two questions per criterion: one to sense their expectation, and the other to sense their perception. Questions were gauged using a 1-7 scale. The gaps between expected and perceived quality of each criterion were used as a proxy to assess the stakeholders' perspectives.

Results obtained are summarised in the figure: "Exploitative labour relations, alienation, and other negative impacts on the well-being of local/tribal communities are the most noticeable social hotspots that prevent the sustainability of palm oil biodiesel." "If palm oil biodiesel is to be produced sustainably, these significant social impacts must be addressed." (Manik et al. 2013).

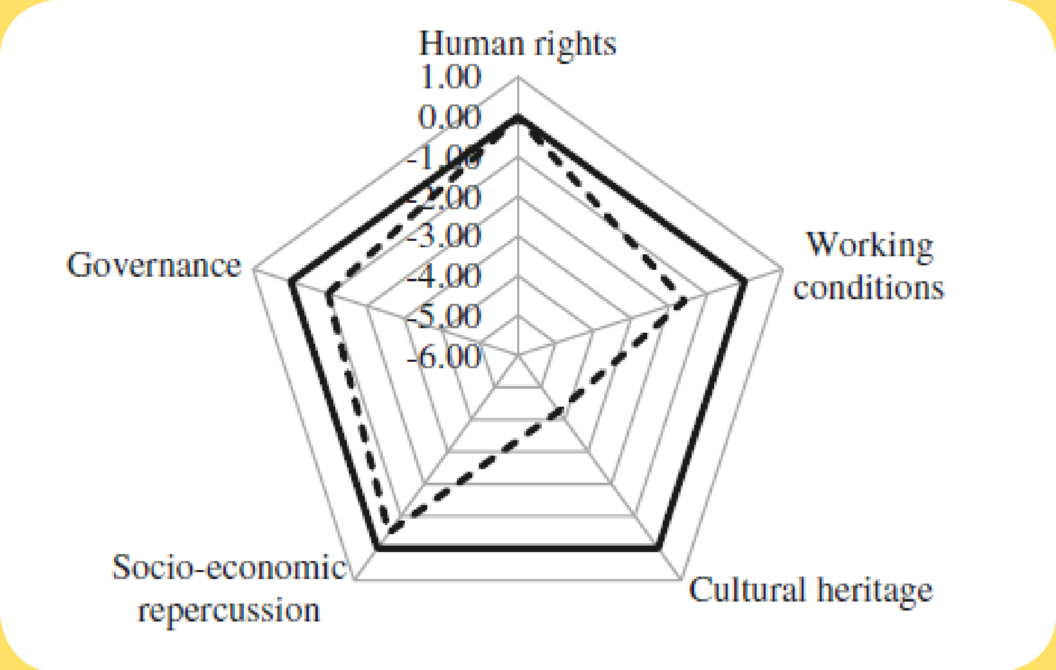


Figure from Manik et al. (2013).

c) Pre-reading

No.	Author and title	Description
1.	UNEP-SETAC. 2009. Guidelines for social life cycle assessment of products. UNEP/SETAC Life Cycle Initiative. United Nations Environment Programme. http://www.unep.fr/shared/publications/pdf/DTIx1164xPA-guidelines_sLCA.pdf	It is the basic document introducing the methodology. This document can be found as TM4-S2-RM2
2.	Bhandari, Ramchandra, Lena Ganda Saptalena, Wolfgang Kusch. Sustainability assessment of a micro hydropower plant in Nepal. "Energy, Sustainability and Society" 2018, Vol. 8, Issue 3. DOI: 10.1186/s13705-018-0147-2	The case study is used in the indicator group work. A summary of it can be found as TM4-S1-AM3
3.	Manik, Yosef, Jessica E. Leahy, Anthony Halog. Social life cycle assessment of palm oil biodiesel: a case study in Jambi Province of Indonesia. "The International Journal of Life Cycle Assessment" 2013, Vol. 18, pp. 1386–1392. DOI: 10.1007/s11367-013-0581-5	The case study used to highlight the importance and usefulness of SCLA.

d) Session activities

Activity 1:

Introductory lecture

Methods	Interactive lecture
Keynotes	None

Materials	**TM4-S1-AM1-Introduction - SLCA (slides 1-7)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA**
Required accessories	Computer + projector
Time allocation	10 min
Learning outcomes	Understanding the basic concept of sustainability assessment (SA) and being aware of the main tools for SA

The purpose of this activity is to introduce the concept of sustainability assessment. After presenting the whole module and its structure the teacher addresses an open question to students (what is Sustainability Assessment?) and, after discussing their answers, provides the definition.

Activity 2:
Presentation on indicators

Methods	Interactive presentation
Keynotes	None
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 8-12)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Understanding of social indicators

The teacher stresses the importance of sustainability indicators. An adequate selection of indicators is needed in order to assess the outcome of policies implemented and provide feedback.
The teacher asks the students what are the characteristics of a good indicator. Students are made to discuss the topic in pairs (for example turning towards the nearest student) before the teacher explains the criteria to select suitable indicators (see Dizdaroglu 2017, table 9).

Activity 3:
Group work on indicators

Methods	Interactive presentation, group work, discussion
Keynotes	The case study for this activity (TM4-S1-AM3) should be given to students before the session.
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 13-18)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA** **TM4-S1-AM3. Sustainability assessment of a micro hydropower plant in Nepal** **TM4-S1-AM4. Template for assessing the social dimension of sustainability of a micro hydropower plant in Nepal**
Required accessories	Computer, projector
Time allocation	20 min
Learning outcomes	Understanding of social indicators

In this activity, students will be divided into groups and they will need to be acquainted with one specific case study of the application of Sustainability Assessment in the energy field in a specific country. The analysis will be undertaken using the template provided by the teacher.

The case study for this activity is presented in the document TM4-S1-AM3 (Sustainability assessment of a micro hydropower plant in Nepal), that should be given to the students before the session. The main facts for the case study are first presented by the teacher, as a reminder. The teacher then divides students into groups of 4-5 people and gives each group a copy of document TM4-S1-AM4 (Template for assessing the social dimension of sustainability of a micro hydropower plant in Nepal). Students are presented with the different “dimensions” considered in the case study but are instructed to focus on the Social Theme. The students are given some 15 minutes to fill in at least one indicator per “dimension” in the Social Theme. The teacher is attentive to the students’ discussions within the groups, answers their questions and provides guidance

After the discussion, the teacher introduces the actual indicators used in the case study (Bhandari et al. 2018). Students may have some comments after comparing their results with the indicators of the article. Students will be aware of the need to identify good, simple and measurable indicators when conducting an assessment of the social impact of energy technologies.

Activity 4:
Introduction to Life Cycle Assessment

Methods	Interactive lecture
Keynotes	None
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 19-24)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA** **TM4-S1-RM1 Video on LCA**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Being aware of the sustainability assessment tools, in this case: LCA

Life Cycle Assessment (LCA) is a widely used product-related assessment tool. It aims to quantify the environmental impact of a product, process or service, accounting for all of the resources consumed and all of the emissions over the several stages of its life cycle.

The purpose of this activity is to provide an overview of the LCA as a sustainability assessment tool. Understanding LCA is basic to understand SLCA. TM4-S1-RM3 is a short video briefly portraying LCA.

Activity 5:
Social Assessment Methods. Social LCA

Methods	Interactive lecture
Keynotes	None
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 25-28)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA**
Required accessories	Computer, projector
Time allocation	5 min
Learning outcomes	Being aware of the social assessment tools, in this case: SLCA

The social assessment toolbox is composed of different families aiming at different goals. These families may include: analytical tools, procedural and management tools, monitoring tools, reporting tools and communication tools (UNEP/SETAC 2009: 30 et seq.).
The teacher provides a non-comprehensive indication of what techniques and tools are available (differences among categories are somewhat diffuse) without going into any detail.

The purpose of this activity is to frame the Social Life Cycle Assessment within the Social Assessment tools.

Activity 6:
Social Life Cycle Assessment Methodology

Methods	Presentation
Keynotes	None
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 29-41)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA**
Required accessories	Computer, projector
Time allocation	15 min
Learning outcomes	Understanding of the SLCA methodology and its features

This activity is a lecture on SLCA given by the teacher, who deepens into the four steps in SLCA:

- Goal and Scope;
- Inventory analysis;
- Impact assessment;
- Interpretation.

Then, the data tools used in SLCA are briefly introduced.

There are some tools that can be used for SLCA development. Mainly some databases which include social indicators. According to Mancini et al. (2018), the two available SLCA databases are:

- PSILCA, a software developed by Greendelta, which provides social indicators for a list of stakeholders and impact subcategories based on the UNEP/SETAC Guidelines (Ciroth, Eisfeld 2016), and
- Social Hotspot Database (SHDB) with the largest amount of social datasets.

Activity 7:
SLCA case studies in the energy field

Methods	Presentation
Keynotes	None
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 42-49)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Exemplifying the usefulness of SLCA through a case study

Examples of the SLCA analyses performed in the energy field are listed. One case study is presented in detail, SLCA of palm oil biodiesel: a case study in Jambi Province of Indonesia (Manik et al. 2013).

The teacher can stress here the usefulness of the SLCA framework: social hotspots are identified that should be addressed. Here the teacher may want to highlight the difficulties of the methodology as well, for instance the difficulties to obtain clear numerical indicator through a survey with questions about perception and expectation using a scale 1-7, and weighting factors for the criteria within an impact category obtained from subjective appreciation of several "experts" representing the different stakeholder categories.

Activity 8:
Instructions for session 2

Methods	Presentation, discussion
Keynotes	The next session will be SLCA practice and for that, the students need to read the document TM4-S2-RM1. Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.
Materials	**TM4-S1-AM1-Introduction - SLCA (slides 50-52)** **TM4-S1-AM2 Class guide and notes for Session 1: Introduction to SLCA** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Understanding of the task for the next session

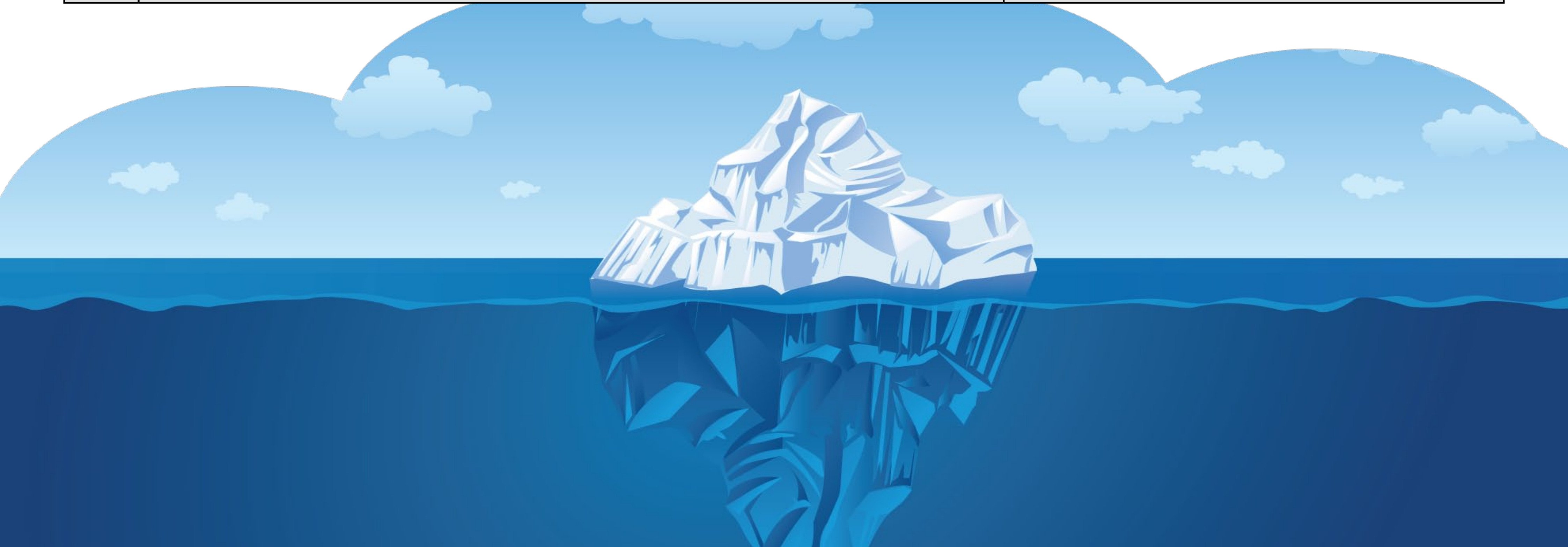
Session 2 will be an SLCA practice. Students need to prepare for it by reading the document "TM4-S2-RM1. Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology". They also would have to skim through "TM4-S2-RM2. Guidelines for Social Life Cycle Assessment of Products." and "TM4-S2-RM3. The Methodological Sheets for Sub-categories in Social Life Cycle Assessment", which are given as additional literature.

As homework, students are asked to prepare, in groups of 4-5 people, a presentation of the case study that will be the basis for the work to be conducted in the second session.

e) Additional resources

No.	Author and title	Description
1.	Petti, Luigia, Monica Serreli, Silvia Di Cesare. Systematic literature review in social life cycle assessment. "The International Journal of Life Cycle Assessment" 2018, Vol. 23, Issue 3, pp. 422–431. DOI: 10.1007/s11367-016-1135-4	A recent review on the SLCA development.
2.	Traverso, Marzia et al. Towards life cycle sustainability assessment: An implementation to photovoltaic modules. "The International Journal of Life Cycle Assessment" 2012, Vol. 17, Issue 8, pp. 1068–1079. DOI: 10.1007/s11367-012-0433-8	One of the case studies used as an example in the slides.
3.	Weldegiorgis, S. Fitsum, Daniel M. Franks. Social dimensions of energy supply alternatives in steelmaking: Comparison of biomass and coal production scenarios in Australia. "Journal of Clean Production" 2014, Vol. 84, Issue 1, pp. 281–288. DOI: 10.1016/j.jclepro.2013.09.056	One of the case studies used as an example in the slides.
4.	Ren, Jingzheng et al. Prioritization of bioethanol production pathways in China based on life cycle sustainability assessment and multicriteria decision-making. "The International Journal of Life Cycle Assessment" 2015, Vol. 20, Issue 6, pp. 842–853. DOI: 10.1007/s11367-015-0877-8	One of the case studies used as an example in the slides.
5.	Ekener-Petersen, Elisabeth, Jonas Höglund, Göran Finnveden. Screening potential social impacts of fossil fuels and biofuels for vehicles. "Energy Policy" 2014, Vol. 73, pp. 416–426. DOI : 10.1016/j.enpol.2014.05.034	One of the case studies used as an example in the slides.

No.	Author and title	Description
6.	Rugani, Benedetto et al. Towards prospective life cycle sustainability analysis: exploring complementarities between social and environmental life cycle assessments for the case of Luxembourg's energy system. "Matériaux & Techniques" 2014, Vol. 102, Issue 6-7, p. 605. DOI: 10.1051/mattech/2014043	One of the case studies used as an example in the slides.
7.	Freudenburg, R. William. Social impact assessment. "Annual Review of Sociology" 1986, Vol. 12, pp. 451-478. DOI: 10.1146/annurev.so.12.080186.002315	Literature review on social impact assessment (SIA).
8.	Fan, Yi et al. 2015. A Review of Social Life Cycle Assessment Methodologies. In: Muthu, S. Subramanian (ed.). Social Life Cycle Assessment. Springer, Singapore, pp. 1-24. DOI: 10.1007/978-981-287-296-8_1	A summary of the state of the art in sLCA methods.



Session 2:

SLCA practical application

a) Session objectives

The session provides a practical overview of the four steps of the Social Life Cycle Assessment by means of a case study. Students will gain an insight of the UNEP/SETAC methodology (UNEP/SETAC 2019) and will face the complexity that practitioners experience when using such methodology.

b) Session scope

This session aims to exemplify the use of SLCA methodology by attempting the assessment of a case study - Evaluation of the social impacts of a Smart Grid implementation in the resort city of Albena, Bulgaria. The students are divided into teams and develop the SLCA step by step following the methodology proposed by UNEP/SETAC (2009), which is used as a framework in most SLCA case studies. The teacher will be providing instructions during the session, guiding the students through several steps.

Case Study: Evaluation of the social impacts of a Smart Grid implementation in the resort city of Albena, Bulgaria using the SLCA methodology

The resort city Albena is located 30 km north of Varna – the Sea capital of Bulgaria. The resort Albena, owned by Albena JSCo, covers an area 140 ha with 3.5 km long and 150m wide beach. There are 34 hotels built in different years with a different star ranking. It is a predominantly summer resort, with one hotel operating during winter since 2017, with a total peak potential to accommodate around 20,000 people (including personnel). There are 7 football stadiums, 19 outdoor and 3 indoor tennis courts, over 25 pools, a horse riding centre and more. Most facilities in the resort are owned by Albena Holding JSCo, including the middle voltage electric grid of 20KV, infrastructure, transport systems within the resort. The resort has been rewarded with the blue flag for being an ecologically clean area.

The A Albena JSCo group consists of several companies operating in diverse industries under the same management, one of them, Perpetum Mobile BG PLC is in the bio-energy industry with 1MW Biogas power plant, located 10 km from the resort.

As an organization, Albena has expressed the willingness to become energy independent for its operations, as well as increasing its revenue stream through implementing year-long operations and marketing the green image of the resort. Figure 1 shows the monthly electricity consumption variation in the resort for the year 2017.

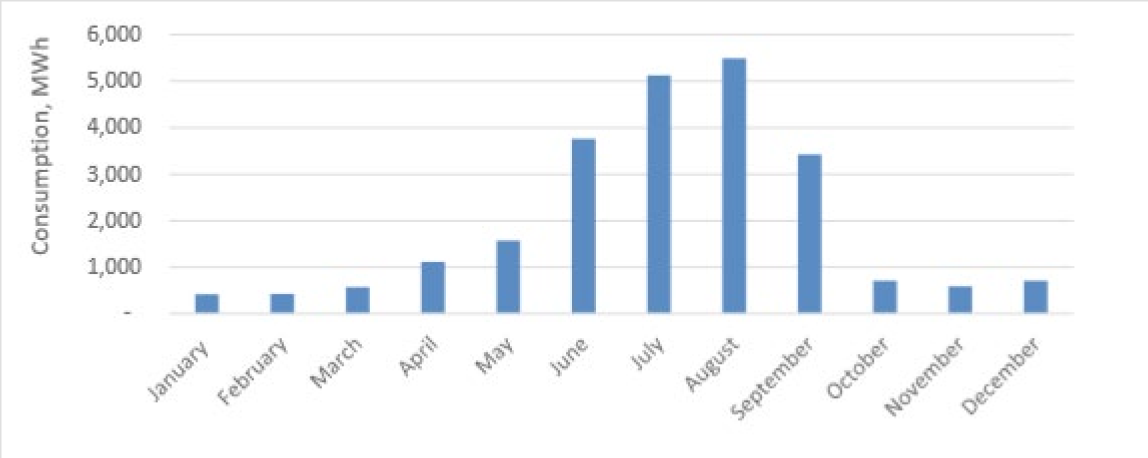


Figure 1. Monthly Electricity Consumption in Albena's resort in 2017

The constant increase in the electricity price for Albena, from 85.0 €/MWh in October 2016 to 99.4 €/MWh in October 2017, makes an investment in energy projects increasingly interesting.

So, a Smart Grid implementation has been considered in Albena, using the same infrastructure but installing additional components such as Smart meters, a SCADA monitoring system, rooftop photovoltaics, Li-ion battery storage and an Electrical Vehicle charging station.

By 2035, as assessed in the SEASON-ALL project (Figure 2), Albena could become an Independent Market Operator and (with a good share of both predictable and fluctuating renewables in the form of Solar, Biogas and also use of heat energy generation) could achieve an 84.6% reduction of electrical power consumption from the external grid.

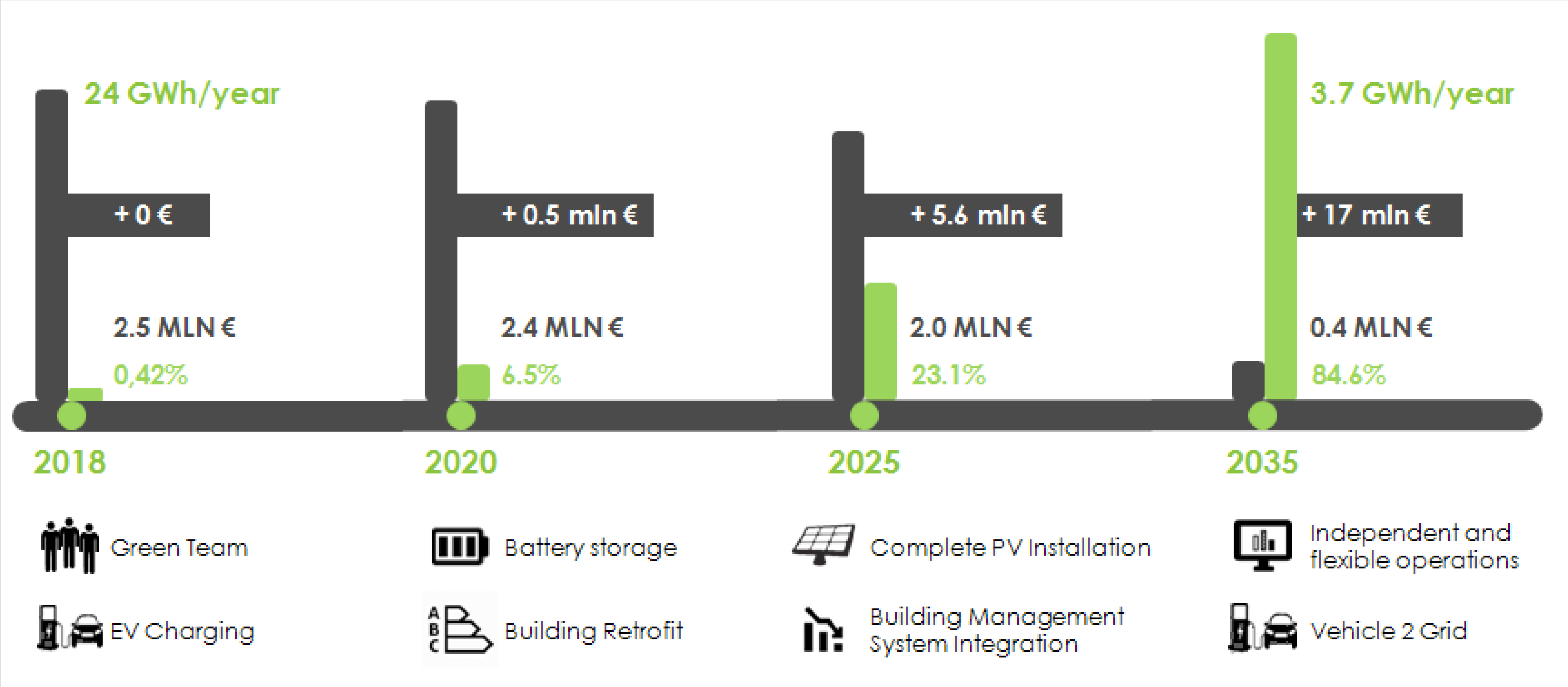


Figure 2. SEASON-ALL project forecasted results for ALBENA (source: D. Kuzeva et al., "SEASON-ALL, Strategies for Energy Autonomy and Seasonal Operations of Albena, Bulgaria," 2018.)

c) Pre-reading

No.	Author and title	Description
1.	Kuzeva, Denitsa. 2018. Evaluation of the social impacts of a Smart Grid implementation in the resort city of Albena, Bulgaria using the SLCA methodology. Code: TM4-S2-RM4	This case study is the basis of Session 2. It is unpublished and it can be found in the support materials.

No.	Author and title	Description
2.	UNEP-SETAC. 2013. The methodological sheets for subcategories in Social Life Cycle Assessment. Code: TM4-S2-RM3	It contains useful examples of the application of the methodology. It is part of the reading materials.

d) Session activities

Activity 1:
Introductory presentation of the case study

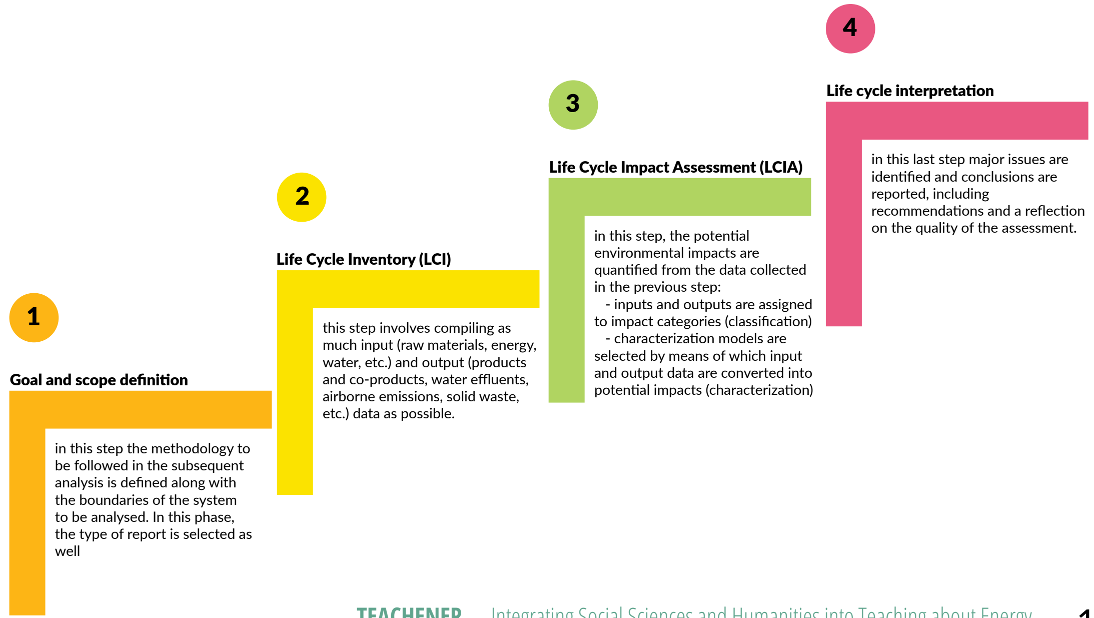
Methods	Presentation, discussion
Keynotes	One group of students is chosen to present their homework for this activity.
Materials	**TM4-S2-AM1 SLCA – practical application (slides 4-8)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application**
Required accessories	Computer + projector
Time allocation	20 min
Learning outcomes	Understanding the case study

After introducing the session's objectives, the teacher chooses a team to present their homework. The students in that group present their slides followed by discussion and clarification of any doubts by the teacher. The teacher can refer to the slides in the presentation to conclude this activity with a brief summary of the case study or can skip these slides if the students' presentation is sufficient.

Activity 2:
Basic steps in the SLCA methodology

Methods	Interactive lecture
Keynotes	None
Materials	**TM4-S2-AM1 SLCA – practical application (slides 9-10)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application**
Required accessories	Computer + projector
Time allocation	5 min
Learning outcomes	A reminder of the basic steps in SLCA

The students are briefly reminded of the basic steps of the Social Life Cycle Assessment methodology (UNEP/SETAC 2009).



Activity 3:
Definition of scope: boundaries

Methods	Workshop, discussion
Keynotes	None
Materials	**TM4-S2-AM1 SLCA – practical application (slides 11-16)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.** **TM4-S2-RM2 UNEP/SETAC Guidelines for Social Life Cycle Assessment of Products.**
Required accessories	Computer + projector
Time allocation	10 min
Learning outcomes	Understanding how to define goal and scope in SLCA

The teacher introduces the goal and scope definition process. Teams of 4-5 student work together and discuss it for the given case study. The students stay together in their group as per the homework for the whole session. Teams need first to define the boundaries of the analysis, that is, what stays in the modelled system and what is kept out of the analysis.
After some time, the teacher presents a proposal for system boundaries.

Activity 4:
Definition of scope: stakeholders

Methods	Workshop, discussion
Keynotes	None
Materials	**TM4-S2-AM1 SLCA – practical application (slides 17-18)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.** **TM4-S2-RM2 UNEP/SETAC Guidelines for Social Life Cycle Assessment of Products.**
Required accessories	Computer + projector
Time allocation	15 min
Learning outcomes	Understanding how to define goal and scope in SLCA

The teacher asks students to brainstorm in their team and write on paper the potential stakeholders, based on the guidelines. Students try to identify the stakeholders of the project. A discussion follows: students discuss their findings lead by the teacher.
The teacher then presents how the author of the case study defines the stakeholders. In order to proceed further, the students may use their own results to continue the analysis or the results of the author of the case study at all times, as they prefer.

Activity 5:
Inventory analysis

Methods	Interactive lecture
Keynotes	None
Materials	**TM4-S2-AM1 SLCA – practical application (slides 19-24)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application**
Required accessories	Computer + projector
Time allocation	15 min
Learning outcomes	A reminder of the main features of the Life Cycle Inventory Analysis.

The teacher presents the main steps in the Inventory Analysis and provides some clues on how to select the impact categories, subcategories and indicators, in order to prepare for the next activity.

In order to produce an SLCA, a large amount of data should be gathered at this point, which is not available or it is not reasonable to be dealt with within this exercise. Some of the data should come from databases, some other should be collected directly (surveys, interviews), some other should be provided by experts. The teacher advises the students that the Impact Assessment that follows intends only to exemplify the method.

Activity 6:
Impact assessment: subcategories and indicators

Methods	Workshop, discussion
Keynotes	Teacher advises the students that the Impact Assessment activity intends only to exemplify the method.
Materials	**TM4-S2-AM1 SLCA – practical application (slides 25-33)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.** **TM4-S2-RM2 Guidelines for Social Life Cycle Assessment of Products.** **TM4-S2-RM3 The Methodological Sheets for Sub-categories in Social Life Cycle Assessment** **TM4-S2-AM3 Template for impact assessment of the case study**
Required accessories	Computer + projector
Time allocation	20 min
Learning outcomes	Understanding how to select subcategories and indicators for local impact in SLCA.

After introducing the concept of Life Cycle Impact Assessment and explaining that, for the sake of simplicity, from now on the analysis will focus only on site-specific indicators, the teacher launches the activity by asking the students to: 1) select impact subcategories for the given stakeholder's categories; and 2) find adequate indicators (at least one per subcategory) for the selected subcategories. After some time, the teacher projects one possible solution, the one given by the author of the case study (TM4-S2-RM4) just to give an example. Students are instructed to keep their answers for the subsequent activity.
To deal with generic indicators, the use of some databases would be necessary (e.g. Social Hotspot Data Base), which is out of reach.

Activity 7:
Impact assessment: weighting factors

Methods	Workshop, discussion
Keynotes	The teacher advises the students that the purpose of the activity is merely illustrative
Materials	**TM4-S2-AM1 SLCA – practical application (slides 34-41)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.** **TM4-S2-AM3 Template for impact assessment of the case study** **TM4-S2-AM4 Template with the rainbow diagram**
Required accessories	Computer + projector
Time allocation	15 min
Learning outcomes	Practising the aggregation of indicators in SLCA

This activity illustrates one of the ways in which the information can be organised. The teacher advises students that this kind of operation requires the concurrence of experts in the field of analysis and that it has a large degree of subjectivity so that good practice is to involve as many experts as possible and average the scores each of them provides.

The teacher instructs the students to score the indicators they found relevant for every local stakeholder.

Impact	Score
very high	8
high	**6**
medium	4
low	2

To do so, students use the template (TM4-S2-AM3) used in the previous activity, filling the columns A, B, C, etc., where the letters stand for each of the local-stakeholders considered (in Activity 2). The scored values are to be added vertically (per stakeholder) and horizontally (per indicator) for different communication purposes.

STAKEHOLDER CATEGORY	SUB-CATEGORIES	INDICATORS	STAKEHOLDERS					
			A	B	C	D	E	F
WORKER								
CONSUMER								
LOCAL COMMUNITY								
SOCIETY								
VALUE CHAIN ACTORS								

The students will work in teams and then teams will compare the results and will discuss among them with the teacher.

After some time, the teacher projects one possible solution, the one given by the author of the case study (TM4-S2-RM4), just to give an example.

Students are free to propose any kind of aggregation, and weighting strategy. Using the weighting factors obtained for the different local stakeholders, students would be able to rank them by being more or less impacted by the project or being more or less influential in the project. Students may use a Rainbow diagram to communicate their findings (using the template TM4-S2-AM4). Alternatively, students may assume an “expert” role in assessing the “affecting/affected” rates of the different stakeholders and build the rainbow diagram on their own criteria. In this case, weighting factors can be obtained from the rainbow diagram which can be used to refine the scores previously obtained.

Activity 8:

Impact assessment: getting values for the indicators

Methods	Workshop, discussion
Keynotes	None
Materials	**TM4-S2-AM1 SLCA – practical application (slides 42-45)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application** **TM4-S2-RM1 Case study: Evaluation of the social impacts of a smart grid implementation in the resort city of Albena, Bulgaria, using the SLCA methodology.** **TM4-S2-AM3 Template for impact assessment of the case study.** **TM4-S2-RM5 Bulgarian National Statistical Institute web site** **TM4-S2-RM6 Forecast of Bulgarian social indicators done by the Pardee Center for International Futures**
Required accessories	Computer + projector

Time allocation	20 min
Learning outcomes	Understanding on how to assess the local impact in SLCA

Finally, the students should use the information from the Bulgarian National Statistical Institute (TM4-S2-RM5) and check for the data available regarding the indicators selected. The teacher should stress the difficulty in finding relevant local data.

In order to quantify the impact of the Albena case study, students might want to quantify the change in some of the indicators after the project is finished, by comparing indicators prior and after (e.g. 2018 vs 2030 forecast). Students should report the value for the current indicator and the potential benefit by 2030.

To estimate values for 2030, for instance, they can take as a reference the potential impact of the deployment of renewable energy by 2030 according to the International Renewable Energy Agency (IRENA 2016). According to this reference, doubling the presence of Renewable Energies in the energy mix would lead to an increase of the GDP of 0.4% and a 3.7% increase of welfare in the new European countries (EU13, which include Bulgaria) in respect to the business as usual (reference) case in 2030.

Another source of information students may use is the web of the Pardee Center for International Futures (Denver University), where some social indicators forecasted for Bulgaria in 2030 can be found (TM4-S2-RM6).

Before proceeding to the next activity, teams compare the indicators and values they have worked in.

Activity 9:
Results, discussion and conclusions

Methods	Workshop, discussion
Keynotes	A group report is to be developed after this session for the final evaluation.

Materials	**TM4-S2-AM1 SLCA – practical application (Slides 46-50)** **TM4-S2-AM2 Class guide and notes for Session 2: SLCA practical application**
Required accessories	Computer + projector
Time allocation	15 min
Learning outcomes	Identify lessons learnt

The teacher explains the interpretation step. Open class discussion on the meaning of the results and limitations of the assessment follows. The teacher summarises the discussion and the whole Teaching Module. Finally, students are asked to prepare a group report of the Session 2 activity within a certain deadline.

Assessment methods and final assignment

The students are asked to prepare a group report of the Session 2 activity within a certain deadline. The groups are graded based on the report and the homework from session 1.

Glossary

CERES	Coalition for Environmentally Responsible Economies
CSR	Corporate Social Responsibility
EPLCA	European Platform On Life Cycle Assessment
GRI	Global Reporting Initiative
LCA	Life Cycle Assessment
LCI	Life Cycle inventory
LCIA	Life Cycle Impact Assessment
NGO	Non-Governmental Organization
PMFA	Product Material Flow Analysis
PSILCA	Product Social Impact Life Cycle Assessment
RM	Reading Material
SA	Sustainability Assessment
SETAC	Society of Environmental Toxicology and Chemistry
SHDB	Social Hotspot Database
SLCA	Social Life Cycle Assessment
TM	Teaching Module
UNEP	United Nations Environment Programme

Attachment: Syllabus

1. Name of the Teaching Module

Social Impact of Energy Technologies. Assessing social impacts through Social Life Cycle Assessment (SLCA)

2. Brief description of the subject matter

Strategies are being developed on the local and global levels to enhance energy security and sustainability through innovative energy policies and measures. The need for practical and sustainable solutions has led to the development of sustainability measurement tools, such as Life Cycle Assessment (LCA). Life cycle assessment (LCA) is widely used for decision support, but it is mainly limited to environmental impacts and fails to address the other dimensions of sustainability - social and economic concerns - in the product life cycle.

As a step further, social criteria may also be included in the sustainability assessment analysis, through the Social Life-Cycle Assessment (SLCA), a tool that analyses the impact on society of products or services throughout their life-cycle, assessing the actual and potential positive and negative impacts. Research on standardization of a methodology for conducting SLCA is limited compared to LCA but it is still ongoing.

The module aims to introduce the SLCA methodology as a tool to measure the main social impacts of energy projects through a life cycle perspective.

3. Complete SSH problems description

- Social indicators are currently being considered for energy projects, along with the technical, economic and environmental aspects. However, the overall social impact on local and global scale is hardly addressed by most currently used methods for social evaluation in the energy field.
- Although some Social Assessment tools exist, most of them lack the global perspective of considering the whole Life Cycle of the product or service.
- Social Life Cycle Assessment, a tool that fills the gap, doesn't have yet an established methodology. Research on the standardization of a methodology for conducting SLCA is going on but still incipient.
- Very few cases of application of SLCA framework to the provision of energy services and in to the energy sector in general

- For SLCA, quantitative and qualitative social impact indicators are needed which are usually difficult to obtain and most of the times subjective.

4. Prerequisites and context

Students can benefit of a previous familiarity with LCA methodology, though it is not essential.

This module is complementary of the 'Technology Assessment' module developed by UFZ, where SLCA is explained and an exercise proposed for students based on developing a SLCA for geothermal energy application. The Technology Assessment module provides a general overview of LCA which may be useful to undertake before this module if students are not familiar with LCA.

5. Learning outcomes

a) Knowledge

a. students will be able to grab the importance of SLCA and contextualize the methodology;

b. students will learn the steps needed to design and conduct a SLCA;

c. students will be able to explain the characteristics of a suitable sustainability indicator framework;

d. students will be aware of the difficulties in obtaining values for indicators on social themes;

e. students will be able to provide compelling examples of the importance of social issues in real energy projects at different scales.

b) Skills

a. Students will be able to understand the design of a SLCA;

b. students will be able synthetize the findings in a report;

c. students will be able to define a number of sustainability indicators;

d. students will be able to estimate values for social indicators.

c) Social competencies

a. Students will be able work in teams in a collaborative atmosphere;

b. students will be able to discuss/debate ideas with an open mind.

6. Form of classes

This module is divided into two sessions.

1. The first session (1 h 30’) is a lecture introducing SLCA, which contains a group work on social indicators

2. In the second session (2 h 15’), the students working in teams will develop a SLCA based on a case study introduced at the end of the first session.

Students will read some aspects of the case study using the provided reading material between the two sessions and will prepare, in teams, a presentation to be shown at the beginning of the second session.

At the end of the second session, students need to compile, as a homework, their analyses in a report.

7. Teaching methods

- Lecture
- Power Point Presentation
- Group work
- Discussion.

8. General classes plan

1. ***Session 1: Introduction – SLCA (2x45 min):*** Sustainability Assessment, Social Assessment Methods, Indicators, Introduction to Life Cycle Assessment, Social LCA methodology, SLCA case studies in the energy field,

i. 10 min introduce of the concept of sustainability assessment by the teacher, stressing its important in the energy field.

ii. 30 min Presentation and group work on indicators.

iii. 30 min Introduction to Life Cycle Assessment, to the Social Assessment Methods, and to the SLCA Methodology.

iv. 15 min SLCA case studies in the energy field, which exemplify the usefulness of the approach.

v. 10 min preparation for session 2

2. Session 2 Develop a S-LCA analysis (3x45)

i. 20 min presentation of the case study (by a team of students)

ii. 5 min remainder by the teacher of the basic SLCA steps.

iii. 95 min Workshop on SLCA development following the main framework (group work on different aspects, and open discussions)

iv. 15 min final discussion on the quality of the work done and the limitations of the methodology.

Material needed

Power point presentation + computer + additional files provided with the TM

Printed Handouts for the activity in the first session (if students don't bring their laptops)

For the second session students should bring at least one laptop per team (in this case, all the handouts can be used in their electronic form).

9. Literature and other materials

Sustainability assessment

1. Bhandari, Ramchandra, Lena Ganda Saptalena, Wolfgang Kusch. Sustainability assessment of a micro hydropower plant in Nepal. "Energy, Sustainability and Society" 2018, Vol. 8, Issue 3. DOI: 10.1186/s13705-018-0147-2

2. Dizarglu, Didem. The role of indicator-based sustainability assessment in policy and the decision-making process: A review and Outlook. "Sustainability" 2017, Vol. 9, Issue 6. DOI: 10.3390/su9061018

3. Freudenburg, R. William. Social impact assessment. "Annual Review of Sociology" 1986, Vol. 12, pp. 451-478. DOI: 10.1146/annurev.so.12.080186.002315

4. Ness, Barry et al. Categorising tools for sustainability assessment. "Ecological Economics" 2007, Vol. 60, Issue 3. DOI: 10.1016/j.ecolecon.2006.07.023

5. Waas, Tom et al. Sustainability assessment and indicators: Tools in a decision-making strategy for sustainable development. "Sustainability" 2014, Vol. 6, Issue 9. DOI: 10.3390/su6095512

Social Life Cycle assessment

1. Ciroth, Andreas, Franziska Eisfeldt. 2016. A Product Social Impact Life Cycle Assessment database. PSILCA Understanding social impacts. https://nexus.openlca.org/ws/files/9062

2. Ekener-Petersen, Elisabeth, Jonas Höglund, Göran Finnveden. Screening potential social impacts of fossil fuels and biofuels for vehicles. "Energy Policy" 2014, Vol. 73, pp. 416–426. DOI : 10.1016/j.enpol.2014.05.034

3. Fan, Yi et al. 2015. A Review of Social Life Cycle Assessment Methodologies. In: Muthu, S. Subramanian (ed.). Social Life Cycle Assessment. Springer, Singapore, pp. 1-24. DOI: 10.1007/978-981-287-296-8_1

4. Kuzeva, Denitsa. 2018. Evaluation of the social impacts of a Smart Grid implementation in the resort city of Albena, Bulgaria using the SLCA methodology. It is unpublished and it can be found in the support material: TM4-S2-RM4

5. Manik, Yosef, Jessica E. Leahy, Anthony Halog. Social life cycle assessment of palm oil biodiesel: a case study in Jambi Province of Indonesia. "The International Journal of Life Cycle Assessment" 2013, Vol. 18, pp. 1386–1392. DOI: 10.1007/s11367-013-0581-5

6. Petti, Luigia, Monica Serreli,Silvia Di Cesare. Systematic literature review in social life cycle assessment. "The International Journal of Life Cycle Assessment" 2018, Vol. 23, Issue 3, pp. 422–431. DOI: 10.1007/s11367-016-1135-4

7. Ren, Jingzheng et al. Prioritization of bioethanol production pathways in China based on life cycle sustainability assessment and multicriteria decision-making. "The International Journal of Life Cycle Assessment" 2015, Vol. 20, Issue 6, pp. 842–853. DOI: 10.1007/s11367-015-0877-8

8. Rugani, Benedetto et al. Towards prospective life cycle sustainability analysis: exploring complementarities between social and environmental life cycle assessments for the case of Luxembourg's energy system. "Matériaux & Techniques" 2014, Vol. 102, Issue 6-7, p.

605. DOI: 10.1051/mattech/2014043

9. Sala, Serenella. 2015. Social Life Cycle Assessment – State of the art and challenges for supporting product policies. JRC Technical Report. DOI: 10.2788/253715.

10. Traverso, Marzia et al. Toward s life cycle sustainability assessment: An implementation to photovoltaic modules. “The International Journal of Life Cycle Assessment” 2012, Vol. 17, Issue 8, pp. 1068–1079. DOI: 10.1007/s11367-012-0433-8

11. UNEP-SETAC. 2009. Guidelines for social life cycle assessment of products. United Nations Environment Programme. http://www.unep.org/pdf/DTIE_PDFS/DTIx1164xPA-guidelines_sLCA.pdf

12. UNEP-SETAC. 2013. The methodological sheets for subcategories in Social Life Cycle Assessment. https://www.lifecycleinitiative.org/wp-content/uploads/2013/11/S-LCA_methodological_sheets_11.11.13.pdf

13. Weldegiorgis, S. Fitsum, Daniel M. Franks. Social dimensions of energy supply alternatives in steelmaking: Comparison of biomass and coal production scenarios in Australia. “Journal of Clean Production” 2014, Vol. 84, Issue 1. DOI: 10.1016/j.jclepro.2013.09.056

14. International Renewable Energy Agency. 2016. Renewable Energy Benefits: Measuring The Economics. IRENA, Abu Dhabi. https://www.irena.org/documentdownloads/publications/irena_measuring-the-economics_2016.pdf

Additional resources

1. Bond, Alan, Angus Morrison-Saunders, Jenny Pope. Sustainability assessment: The state of the art. “Impact Assessment and Project Appraisal” 2012, Vol. 30, Issue 1. DOI: 10.1080/14615517.2012.661974

2. Botelho, Anabela et al. Social sustainability of renewable energy sources in electricity production: An application of the contingent valuation method. “Sustainable Cities and Society” 2016, Vol. 26. DOI: 10.1016/j.scs.2016.05.011

3. Carneiro, Aurora et al. Sustainability, Energy and Development: A Proposal of Indicators. “International Journal for Infonomics” 2012, Vol. 5, Issue 1/2. Online. DOI: 10.20533/iji.1742.4712.2012.0060

4. Colantonio, Andrea. 2009. Social sustainability: a review and critique of traditional versus emerging themes and assessment methods. In: Horner, Malcolm et al. (eds.). Sue-Mot Conference 2009: Second International Conference on Whole Life Urban Sustainability and Its Assessment: Conference Proce. Loughborough University, Loughborough.

5. EPLCA European Platform On Life Cycle Assessment https://eplca.jrc.ec.europa.eu/

6. GRI. 2011. Sustainability Reporting Guidelines. Global Reporting Initiative https://www.globalreporting.org/resourcelibrary/G3.1-Guidelines-Incl-Technical-Protocol.pdf

7. Hirschberg, Stefan et al. 2007. Environmental, economic and social criteria and indicators for sustainability assessment of energy technologies. NEEDS FP6 project. New Energy Externalities Developments for Sustainability. http://www.needs-project.org/RS2b/RS2b_D3.1.pdf

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9. Jorgensen, Andreas et al. Methodologies for social life cycle assessment. "International Journal Life Cycle Assessment" 2008, Vol. 13. DOI: 10.1065/lca2007.11.367

10. De Luca, Anna Irene et al. Social Life Cycle Assessment and participatory approaches: a methodological proposal applied to citrus farming in Southern Italy. "Integrated Environmental Assessment and Management" 2015, Vol. 11, Issue 3. DOI: 10.1002/ieam.1611

11. Mancini, Lucia et al. 2018. Social assessment of raw materials supply chains: A life-cycle-based analysis. JRC Technical reports. http://publications.jrc.ec.europa.eu/repository/bitstream/JRC112626/social_risk_technical_report_third_review_round_final_18_01_19_online.pdf

12. Popovic, Tamara et al. Quantitative indicators for social sustainability assessment of society and product responsibility aspects in supply chains. "Journal of International Studies" 2017, Vol. 10, Issue 4. DOI: 10.14254/2071-8330.2017/10-4/1

13. Santoyo-Castelazo, Edgar, Adisa Azapagic. Sustainability assessment of energy systems: integrating environmental, economic and social aspects. "Journal of Cleaner Production" 2014, Vol. 80, Issue 1. DOI: 10.1016/j.jclepro.2014.05.061

14. Shiau, Tzay-An, Ji-Kai Chuen-Yu. Developing an Indicator System for Measuring the Social Sustainability of Offshore Wind Power Farms. "Sustainability" 2016, Vol. 8, Issue 5. DOI: 10.3390/su8050470

15. Whitton, John et al. Conceptualizing a social sustainability framework for energy infrastructure decisions. "Energy Research & Social Science" 2015, Vol. 8. DOI: 10.1016/j.erss.2015.05.010

16. Wolf, Marc-Andree et al. 2012. The International Reference Life Cycle Data System (ILCD) Handbook. JRC Reference Reports. https://

eplca.jrc.ec.europa.eu/uploads/JRC-Reference-Report-ILCD-Handbook-Towards-more-sustainable-production-and-consumption-for-a-resource-efficient-Europe.pdf

17. Wu, Ruqun, Dan Yang, Jiquan Chen. Social Life Cycle Assessment Revisited. “Sustainability” 2015, Vol. 6, Issue 6. DOI: 10.3390/su6074200

TM5

Technology Assessment

An approach for organizing societal discourse on innovative energy technologies

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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

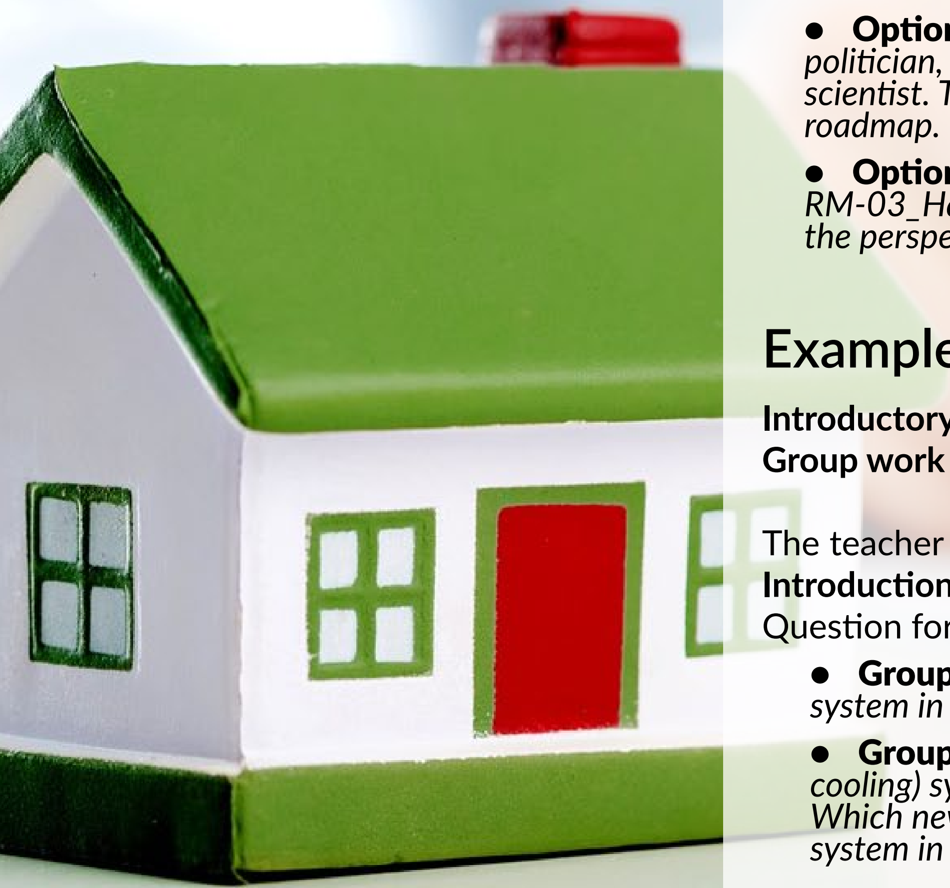
Methods	Lecture
Keynotes	None
Materials	**TM5-S1-RM-01_ppt_introduction TA**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Students gain a first impression of the module content. They conduct a short group work exercise that introduces them to the basic principles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

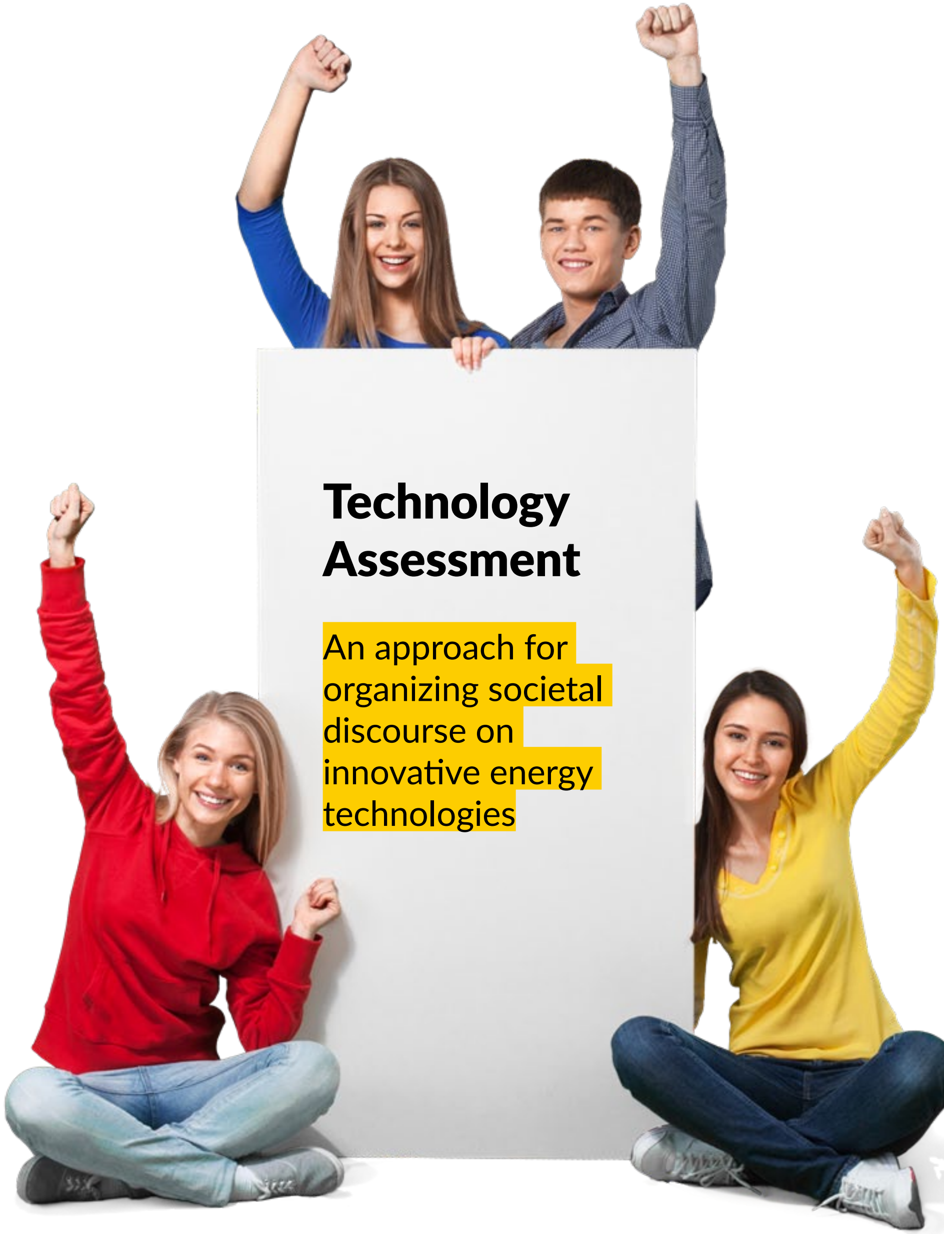
Introductory material teacher: TM5-S1-RM-05_Introduction new heating system_teacher
Group work teaching material: TM5-S1-RM-06_Handout_New heating system

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

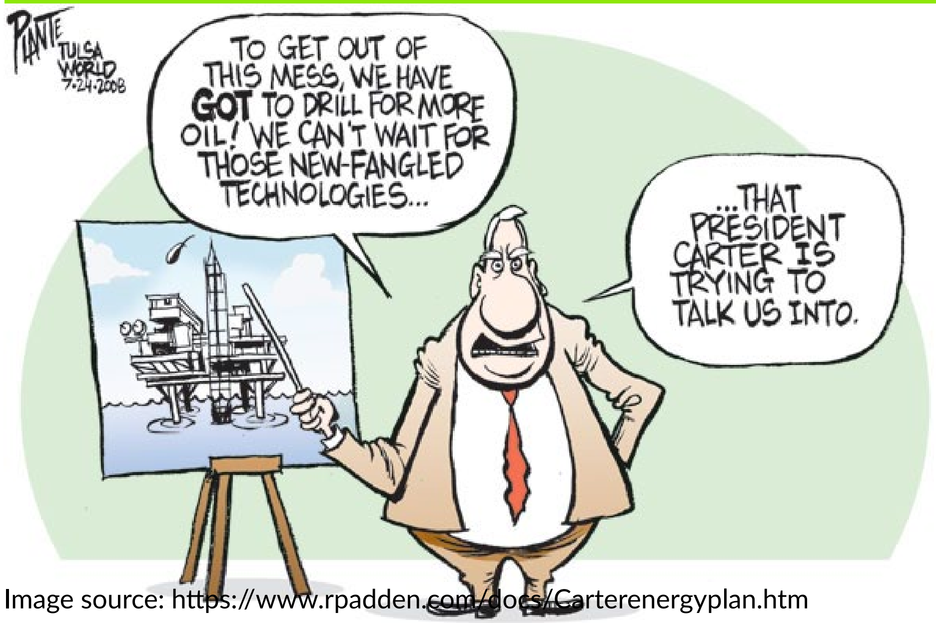


Image source: https://www.rpadden.com/docs/Carterenergyplan.htm

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).

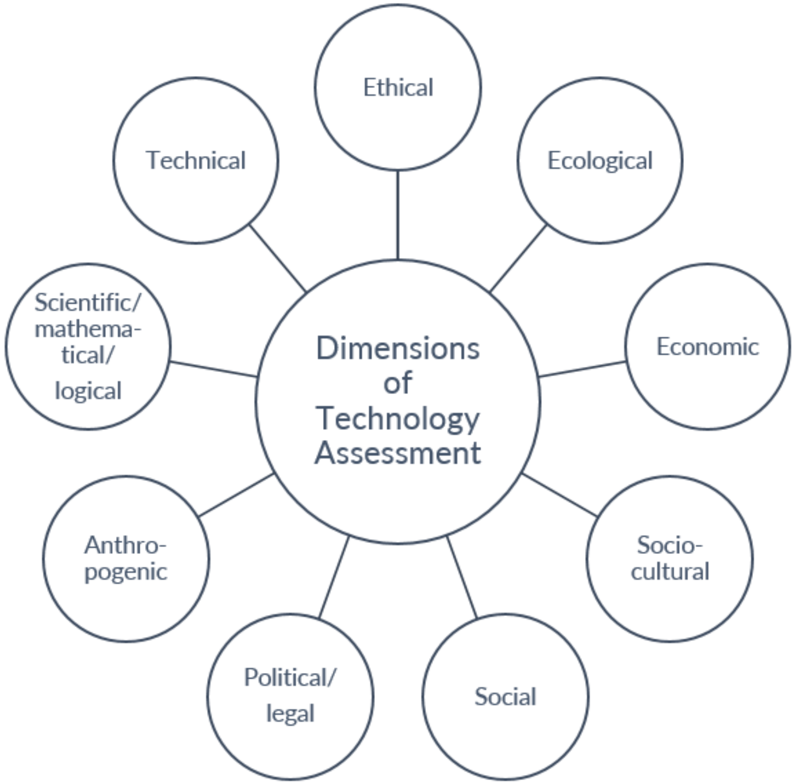
Activity 4: Lecture

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.

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.
There are many methods of technology assessment. In the frame of this module the basic idea of Life Cycle Assessment will be introduced more precisely. It will be shown how SSH issues can be taken up within the method of LCA. Throughout the units of the module theoretical and methodological aspects will be linked to examples of energy research and energy technology development. Based on group works students will work out some of the contents.

3. Complete SSH problems description

- It has been observed for centuries that technological change always impact societies and creates winners and losers. Each technology (or family of technology) has unforeseeable implications for society. Nowadays it is considered that impacts of technologies on society have to be analyzed, assessed and evaluated.
- Since the 1970s the assessment of technologies has developed as an interdisciplinary research of technological impacts on society. TA became institutionalized in many countries to generate knowledge for public discourse and policy advice. TA institutions play a crucial role and shape research on and development of energy technologies.
- A basic understanding of assumptions, principles, and main goals of TA as well as its functions in society and policy is useful for those who do research and develop energy technologies.
- A major challenge for TA is: how to integrate societal perspectives into the assessment of technologies. Methods and approaches to deal with this issue will be part of the module in order to trigger awareness to this point.

4. Prerequisites and Contextual knowledge

There are no prerequisites except the interest for the topic. The module addresses master and PhD students, but bachelor students would also be able to attend.

5. Learning outcomes

A) KNOWLEDGE

The students will learn about the idea, concept, role and institutions (actors) of technology assessment and how it applies to energy technologies. The module will allow the students to expand their knowledge about the methods, basic assumptions, main goals and TA's role in and for society and policy. This includes knowledge about the relation and difference between TA and risk assessment, current trends in TA, and some specific methods such as sLCA.

B) SKILLS

The content of the module will enable the students to apply their newly gained knowledge on TA in further studies of energy issues. They will become aware of the importance of technology assessment for a socially acceptable technological development. By practical exercises and work with TA reports students will acquire skills in analyzing reports and deriving relevant information from texts. Students will learn how to apply knowledge to examples from practice.

C) SOCIAL COMPETENCIES

Through practical exercises and group work students acquire social competencies such as collaborative work.

6. Form of classes

- The module will consist of 3 sessions (see point 8) of 1,5 hours each. These lessons can be taught connectedly on one day or on three single days. If the module is taught on one day it is required to have breaks between the sessions and a bigger break between the second and third session.
- All sessions will combine group work exercises, traditional lecture formats to introduce the issues of technology assessment and discussions.
- There is homework to be done by the students (two texts should be read) between the first and the second session. If you want to teach the module in one day they should be read before the module.

7. Teaching methods

- Lectures
- Power Point Presentations
- Group works
- Interactive Brainstorming
- Discussions

8. Class plans

1. Session – History and functions of technology assessment (Group work, lecture supported by PowerPoint Slides)

Time: 1,5 hours

- 10 minutes introduction by the teacher (introduction to the overall goal of the module and introduction to the group work)
- 20 min group work
- 35 min discussion of the group work results
- 25 min lecture on the history and functions of technology assessment

Description of the tasks
In this session the teacher introduces the overall goal and the agenda of the module and briefly explains the content of the three lessons. The teacher choses one of the two examples described and introduces the following group work. Regardless of which example is chosen, the students form groups of 3-4 people. The students are asked to take notes during the group work, so that they can document the main points of the discussion. 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 central aspects that have to be taken into account when assessing technologies. After the joint discussion the teacher will give a lecture on the history and functions of technology assessment, whereas the experience of the discussion can be used as a starting point.

Material needed

- TM5-S1-RM-01_ppt_introduction TA
- TM5-S1-RM-02_EU_Energyroadmap_2050
- 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
- TM5-S1-RM-08_ppt_history TA
- TM5-S1-RM-09_national energy plan 1977
- TM5-S1-RM-10_report Chernobyl nuclear power plant

Teacher-student / student-student interaction

- Traditional lecture
- Group work
- Presentation and discussion

2. Session – Technology Assessment today – Dimensions of TA: Group work exercise, lecture supported by PowerPoint Slides

Time: 1,5 hours

- 10 min introduction
- 35 min text based group work
- 30 min discussion of the group work
- 15 min lecture on the dimensions of technology assessment

Description of the tasks

The teacher briefly introduces the content of this session. He/she explains the starting point of this session: a group task about policy briefs that provide condensed technology assessments related to an energy issue. The students are asked to form groups of three or four people. Each group discusses one of the policy briefs: environmental impact of tidal energy barrages (POST 2013) OR energy-efficient office buildings (ITA 2016). The students are asked to take notes in order to document the main points of the discussion. The discussion is guided by the teacher, who encourages the students to reflect on and discuss the content of the previous group work. 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). After the discussion the teacher will give a short lecture on the dimensions of technology assessment, whereas the experience of the discussion can be used as a starting point.

Material needed

- TM5-S2-RM-00_Session scope
- 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
- TM5-S2-RM-05_Discussion questions_teacher
- TM5-S2-RM-06_ppt_dimensions TA

Teacher-student / student-student interaction

- Traditional lecture
- Group work
- Presentation and discussion

3. Session – Actors and Methods of Technology Assessment

Time: 1,5 hours

- 55min lecture on the actors and methods of TA
- 10min brainstorming
- 15min discussion of the brainstorming
- 10min summary

Description of the tasks
Information on the content of this lecture can be found in the E-book.
At first the teacher gives a lecture about the actors and methods of technological assessment with a deeper insight in social life cycle assessment. The lecture ends with the introduction of the UNEP-Scheme of social LCA (UNEP 2009: 45). The following task is based on this scheme. Ask the students to find a partner and brainstorm in pairs about the given questions. The students are asked to come up with an sLCA concept for shallow geothermal energy installations that is based on the UNEP guidelines for social LCA. In the following discussion guided by the teacher, the students should share the ideas they came up with during the brainstorming session. In the end the teacher summarizes the content taught during the module and highlights the central points of the exercises and discussions.

Material needed

- TM5-S3-RM-01_ppt_actors & methods of TA and sLCA
- TM5-S3-RM-02_UNEP-Scheme_sLCA
- TM5-S3-RM-03_Handout brainstorming
- TM5-S3-RM-04_Handout brainstorming_teacher
- TM5-S3-RM-05-ppt_last slide

Teacher-student / student-student interaction

- Traditional lecture format
- Discussion student-student and student-teacher

9. Literature

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TM6

Smart metering

Social risk perception and risk governance

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Introduction

The goal of this teaching module is to broaden the understanding of technology-related risks and to present the concepts of social risk perception and risk governance in the context of smart metering technology.

In current phase of technological development – known as the fourth industrial revolution – rapid and profound changes are setting up new and particularly destabilizing risks. In more and more complex technological systems that constitute modern life, the risks become difficult to identify and even more difficult to measure and manage. Many of the technologies, such as artificial intelligence (AI) or genetically modified organisms (GMO) are considered from this point of view. A demonstrative example from the energy sector is smart metering (SM) technology.

» *Smart metering means, inter alia employing communication technologies to exchange information between electric companies and their customers, and sensing technologies to constantly measure the quantity and quality of electricity being transferred over the grid, which is thus called the smart grid (SG).*

» *Smart grid is a complex system comprising numerous interconnected components – controls, computers, measuring devices, and other digital equipment, as well as advanced software and applications – working together and exchanging information.*

In electrical smart grids, becoming enormously complex systems, it's difficult not only to mitigate but also to recognize and estimate even relatively isolated technological risks, such as for example the risk of a cyberattack interrupting supply of electricity.

» *In an increasingly interconnected world new technology-related risks – such as for example the "big brother" effect, or security of energy consumers' private data – are emerging and raising additional technical, social and political concerns.*

The dilemmas call for proper governance of SG and SM development. It should be comprised of both: application of suitable technical tools (i.e. secure transfer of sensitive data), and also implementation of appropriate political and social instruments. Exemplary of the latter may include inter alia decision making on who and how should govern the energy consumers' data or to what extent the technical innovations should be integrated into the community. Rapid development of smart grids and smart meters (as well as other modern technologies) requires farsighted policy and social awareness to avoid harming the society.

Using the example of SM, a *'risk governance' framework* is introduced in the course. It consists of three main parts: risk perception, risk communication and risk management. All of them are subsequently presented and discussed in the respective sessions.

The teaching module is composed of 4 successive sessions:

1

Session 1: Smart grids and smart meters
introduces the technical and economic aspects of Smart Grids and smart metering technology.

135 minutes

2

Session 2: Risk perception
deals with risk perception concept and its historical development.

120 minutes

3

Session 3: Risk communication
is devoted to presenting the existing risk communication approaches in the context of different "controversial technologies", such as nuclear energy, radioactive waste management or genetically modified food.

135 minutes

4

Session 3: Risk management
discusses different risk management and governance strategies – stretching out from uniquely expert risk estimation and decision-making to broad public debates with the involvement of different stakeholders.

135 minutes

Session 1:
Smart grids and smart meters

a) Session objectives

This session is intended to give students an inside general knowledge of what smart meters are, how they operate, how they cooperate in a grid, what are the benefits of smart meter use etc.

b) Session scope

Introduction

A smart meter is an advanced electricity meter (less often gas or heat meter), which measures energy consumption of the consumer, and additionally collects other information regarding this consumption (e.g. voltage, phase angle and frequency) that may be useful for the energy supplier and / or consumer.

Smart meters can read information about energy consumption and its parameters and send them via communication networks to remote data centers in real-time.

» *Smart meters employ sensors to identify various physical parameters, and communication devices to transfer the data. Smart meters usually employ two-way communication between the meter and the energy company.*

It enables not only gathering information from the meter (regarding the energy supplied, times of peak usage etc.), but also sending information and / or commands to the meter (regarding e.g. current electricity prices, operation schedules etc.)

An integrated system of numerous smart meters, communication networks, and data management system, that facilitates two-way communication between energy company and its customers is defined as advanced metering infrastructure (AMI). AMI and smart meters constitute an important part of **smart grid** infrastructure – infrastructure of a power grid designed for enhanced efficiency and reliability of energy supply (using automated controls, IT and communications technologies, sensing and metering devices, energy management techniques, and the like) (Patel, Modi 2015).

Applications

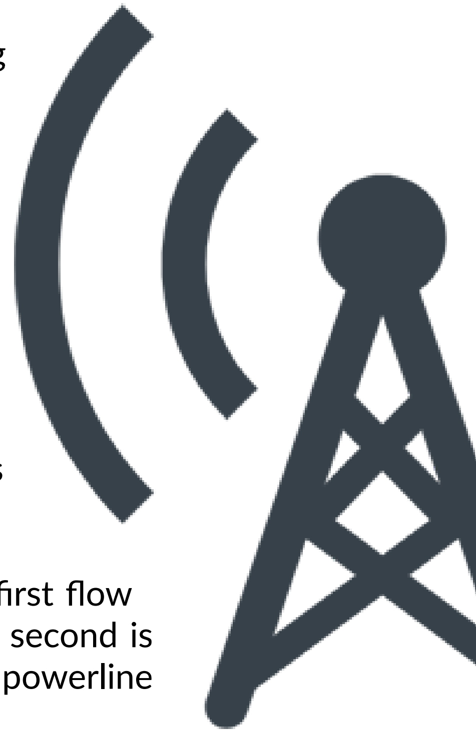
The range of possible applications of smart meters is just beginning to reveal itself and the technology starts to reach a wide audience. These meters can not only measure electricity consumption (or even bill customers), but they can also collect massive statistical and diagnostic information about distribution grids, electricity equipment in households, or decentralized units of energy generation and / or storage.

Thanks to the communication capabilities, smart meters can be used to monitor, as well as to control household appliances and devices connected to the grid at customers' sites. Other possible applications include controlling the maximum consumption of electricity and disconnecting / reconnecting the electrical supply to any customer. To perform those tasks, smart meters can also communicate with one another.

Real-time data on energy consumption from a large number of smart meters (i.e. energy consumers) allow energy companies to effectively employ **demand side management** techniques. Combined with in-home displays, smart meters can reveal information to end-users about periods when higher energy prices are in effect, which should encourage consumers to save money. Smart meters can bring new time-based rate programs or even directly control the work schedules of home appliances and other energy devices. In addition, smart meters also help to detect unauthorized consumption and theft of electricity.

All of these new services and applications impose the need of collecting large amounts of data on energy consumption on energy utilities, also in real time. That's where smart meters come in action and give the functionality required.

Communication



The most important aspects of smart meters technology include security and safety requirements regarding communication networks and communication devices. The use of smart meters involves transfer of a huge amount of data between energy companies, the meters and household appliances powered thru the meters. These data are confidential and access to them should be authenticated. Guidelines and standards for security of transmission, collection, storage and maintenance of energy data in smart grids have been formulated and are under implementation.

Data transmission in smart grids allows to employ various communication technologies, both wired and wireless. Wireless communication has certain advantages over wired technologies – the most important are cheaper infrastructure and the possibility of connecting to energy users in less accessible areas. On the other hand, wireless transmission is vulnerable to interference and signal weakening, which applies to wired solutions to a lesser extent.

Generally, two types of information infrastructure are used for information flow in a smart grid system. The first flow is from sensors and electrical appliances to smart meters (which can be a part of the Internet of Things), the second is between smart meters and the energy utility's data centers. The first data flow can be accomplished through powerline communication (PLC) or wireless communications, such as ZigBee, Z-wave, and others. For the second information flow, cellular technologies or the Internet can be used. It is expected that part of this infrastructure will make use of the power distribution lines themselves as communications carriers using broadband PLC technology (Patel, Modi 2015).

Nevertheless, there are several factors that should be taken into account in the smart metering deployment process, such as time of deployment, operational costs, the availability of the technology and rural/urban or indoor/outdoor environment, etc. The technology choice that fits one environment may not be suitable for the other. An overview of some smart grid communication technologies is indicated in the table below.

Technology	Spectrum	Data Rate	Coverge Range	Applications	Limitations
GSM	900 - 1800 MHz	Up to 14.4 Kbps	1-10 km	AMI, Demand Response, HAN	Low data rates
GPRS	900 - 1800 MHz	Up to 170 Kpbs	1-10 km	AMI, Demand Response, HAN	Low data rates
3G	1.92-1.98 GHz 2.11-2.17 GHz (licensed)	384 Kpps-2Mbps	1-10 km	AMI, Demand Response, HAN	Costly spectrum fees
WiMAX	2.5 GHz, 3.5 GHz, 5.8 GHz	Up to 75 Mbps	10-50 km (LOS) 1-5 km (NLOS)	AMI, Demand Response	Not widespread
PLC	1-30 MHz	2-3 Mbps	1-3 km	AMI, Fraud Detection	Harsh, noisy channel environment
ZigBee	2.4 GHz-868-915 MHz	250 Kbps	30-50 m	AMI, HAN	Low data rate, short range

Source: Umang M, Patel & Modi, Mitul. (2015). A Review on Smart Meter System. IJIREEICE. Vol. 3, no. 12, pp. 70-73.

The communication infrastructure in smart grid requires two-way communications, interoperability between advanced applications and end-to-end reliable and secure communications with low-latencies and sufficient bandwidth. Moreover, the system security should be robust enough to prevent cyber-attacks and provide system stability and reliability with advanced controls. Secure information gathering, transmission, and storage are critical issues for energy companies and their customers, especially due to grid control and billing purposes. To avoid cyberattacks, efficient security mechanisms regarding communication in smart grid should be developed and applied.

Another critical issue is providing the reliability of the smart grid infrastructure. Combining different communication and information technologies and protocols, numerous advanced intelligent and electronic devices, controls etc. with power grid infrastructure from substation to customer meters, requires significant reliability and robustness of the whole system.

Controversies

Although smart meters for electricity have received widespread acclaim as a means to achieve more resilient and sustainable electricity consumption, public opposition has emerged in several countries. In North America concern with the health effects of wireless smart meters has been an important reason given by opponents of this technology, but frequently the reasons for opposition are bundled into a group that also includes security, privacy, and excessive costs. In some cases, people who would otherwise support smart meters due to their environmental beliefs have rejected them due to this bundle of concerns. These opponents appear to represent only a minority of households and businesses, but they have been persistent and vocal enough that they have achieved some policy responses (SE GB 2019).

c) Pre-reading

No.	Author and title	Description
1.	Umang, M. Patel, Mitul Modi. A Review on Smart Meter System. „IJ IREEICE" 2015, Vol. 3, Issue 12, pp. 70-73. DOI: 10.17148/IJIREEICE.2015.31215	The paper presenting a brief literature review of the work carried out by the various researchers in this field by using smart meters and the various communication system used in smart metering technology.
2.	The campaign for a smarter Britain https://www.smartenergygb.org/en	Webpage of Smart Energy GB – non-governmental British organization acting in favor of the smart meter roll-out –helping to understand smart meters by the broad public.
3.	Discover Smart Meters & Smart Grids http://my-smart-energy.eu	Webpage of EDSO for Smart Grids – European Distribution System Operators' Association for Smart Grids, acting in favor of smart metering and smart grids roll-out across of Europe – helping to understand smart meters and smart grids by the broad public.

d) Session activities

Activity 1: Introductory lecture

Methods	Interactive lecture
Keynotes	This presentation is a general introduction to technical aspects and comments on SSH issues should be avoided.
Materials	**TM6-ST1-RM1-Smart metering - introductory lecture**
Required accessories	Computer + projector
Time allocation	30 min
Learning outcomes	Understanding of smart grids on the basis of smart meters

The lecture presents and explains what Smart Meters are, how they operate, how they cooperate in a grid, what are the benefits of Smart Meter use. An evolutionary explanation of the development of meter technology is given. The lecture presents and explains what are different advancements in Smart Meters and what are their capabilities in each respect. A broad application benefits comparison is given which illustrates the capabilities available thanks to Smart Meters' Smart Grid advancements. Basic operations of a Smart Meter system are covered and discussed with the focus on communication. Initial information on security issues is presented in context of privacy and legislation.

Activity 2:
Presentation of end-user energy consumption data management

Methods	Participatory lecture
Keynotes	The calculations provided in the presentation are simple and should be treated as examples elaborating on the procedure. They are the introduction to activity 3.
Materials	**TM6-ST1-RM2-End-user energy consumption**
Required accessories	Computer + projector
Time allocation	20 min
Learning outcomes	Understanding of energy consumption

The goal of activity 2 is to provide understanding of the general concept of end-user energy consumption and its everyday application. The awareness of the omnipotence of energy consumption in all energy consumer systems is raised and the lack of basic knowledge by users evidenced. The idea of energy savings translated to savings is presented based on optimization of energy consumption based on the information feedback. The simplicity of calculating end-user energy consumption cost is presented with focus on basic required information. The general step procedure of calculations is presented on a given example with step by step instructions and clarification. Basic energy consumption tables are given. Time variance pricing concept is introduced with the explanation of the need for its existence. Innovative variable tariffs are covered with the automation technology explanation which can automatize the process of consumption control. As a proof for the concept, an example calculation is conduced and the results discussed. Finally, advantages of being aware of energy tariffs in conjunction with the use of Smart Meters are perpetuated.

Activity 3:
End-user energy consumption data calculation

Methods	Webquest, computer workshop
Keynotes	A good explanation of the task is very important. Comment on differences in tariffs in EU.
Materials	**TM6-ST1-RM3-Cost calculation exercise (blank)** **TM6-ST1-RM4-Cost calculation exercise (CES - dishwasher)** **TM6-ST1-RM5-Cost calculation exercise (Endesa - air conditioner)** **TM6-ST1-RM6-Energy tariffs** **TM6-ST1-RM7-Cost calculation example - instructions for students** **TM6-ST1-RM8-Cost calculation example - instructions for teacher** **TM6-ST1-RM9-Energy-label-air-conditioner-example** **TM6-ST1-RM10-Energy-label-dishwasher-example**
Required accessories	Computer laboratory
Time allocation	50 min
Learning outcomes	The skill to calculate and evaluate energy consumption

The main goal of this activity is for the students to practice energy consumption calculations and to realize, that by adjusting the energy tariff the cost of energy may vary significantly. In addition, time shifting the use of some appliances may bring additional savings. This time shift may be done by Smart Meters semi or fully automatically. Students are asked to calculate energy consumption cost for specific household appliances based on the provided handouts with the use of a pre-prepared spreadsheet. The teacher should divide the class into 2-3 groups. Common assumptions should be made. Each group should be asked to perform the calculations for the same appliance but for different tariffs from different EU countries. This will provide comparison material for the activity summary.

Activity 4:
Discussion on energy consumption data management

Methods	Panel discussion
Keynotes	The discussion should be guided to reach a conclusion that Smart Meters pose also social risks.
Materials	**None**
Required accessories	None
Time allocation	35 min
Learning outcomes	Understanding the energy consumption information flow

The main idea of this discussion is for the students to come to a conclusion that Smart Meters have not only advantages but also disadvantages which are not all technically based. After a brief summary of activity 3 in the form of voluntary exclamations, the students are asked to think and present the ideas on how is information transferred from the Smart Meters to the stakeholder. The guided discussion should elaborate on the “route” (IoT – Internet of Things) of information and possible danger that may arise in the course of this transfer. The discussion should be guided to come to a conclusion, that besides technical dangers, there are also social ones – to be discussed in later sessions.

Activity 5:
Assignment with further work

Methods	Discussion
Keynotes	Ask the students to make notes from their discoveries.
Materials	**TM6-ST1-RM11-Toronto**
Required accessories	None
Time allocation	Home assignment
Learning outcomes	Ability to analyze public discourse on smart metering

Students are asked two things: first, to look in the Internet for cases of public debates on smart metering and identify all the risks appearing in the discussion. Second, to study at home materials on a case of Toronto city, which will be the subject of the next session.

e) Additional resources

No.	Author and title	Description
1.	U.S. Department of Energy, Office of Electricity Delivery and Energy Reliability. 2016. Advanced Metering Infrastructure and Customer Systems: Results from the Smart Grid Investment Grant Program. https://www.smartgrid.gov/document/SGIG_Results_for_AMI_and_Customer_Systems_2016.html	This report shares key results and benefits from the 70 Smart Grid Investment Grant (co-financed by U.S. DOE) projects implementing AMI and customer system technologies, and also documents lessons learned on technology installation and implementation strategies.
2.	Gungor, C. Vehbi et al. Smart Grid Technologies: Communication Technologies and Standards. „IEEE Transactions on Industrial Informatics" 2011, Vol. 7, Issue 4, pp. 529-539. DOI: 10.1109/TII.2011.2166794	The paper provides a better understanding of the technologies, potential advantages and research challenges of the smart grid and provoke interest among the research community to further explore this promising research area.
3.	Hess, J. David. Smart Meters and Public Acceptance: Comparative Analysis and Design Implications. „Health, Risk & Society" 2014, Vol. 16, Issue 3, pp. 243-258. DOI: 10.1080/13698575.2014.911821	The study examines patterns in public opposition, suggests hypotheses for future research, and compares two policy strategies, one of which views public opposition as a lack of good communication from utilities and the other of which views it as an opportunity for innovation in overall systems design.

Session 2: Risk perception

a) Session objectives

This session has as its aim to get the students introduced with specificity of technological risk perception and teach them to identify possible risks which might be important for various groups of people (sometimes called stakeholders). Students should be also able to understand the causes in differences in risk perception between experts and lay-people and to categorize risks according to their character, actors who perceive them and sphere they apply to.

b) Session scope

Introduction

Risk perception belongs to classical motifs of social history of technology. Stretching back to the beginnings of modern scientific and technological era, when first innovations like cars and trains arouse social fears and faced the problem of acceptability, risk perception became crucial in the 70's of 20th century. Development of new technologies, especially the atomic energy, resulted in intensive public protests and unease with the fast pace of technological innovations. Psychometric studies, initiated in the 70's at the University of Oregon, tried to answer the question why (from the expert point of view) lay-people incorrectly perceive risks related to new technologies. Why they fear things which (again, from the expert point of view) are irrelevant, negligible or even do not exist. Why do people fear nuclear energy, pesticides, spray cans or large constructions much more than they are 'really' (it means due to the experts evaluations) risky? Why do people refuse building a nuclear power point in their neighborhood, while at the same time they smoke cigarettes risking lung cancer, drive cars risking road accidents etc.? Answering these question and understanding the social perception of risk became even more pressing, as new controversial technologies came to use: such as genetically modified organisms in the 80's and nanotechnologies in the 90's. Reflection of the social perception of risk allowed to identify a number of factors influencing how people perceive risks related to new technologies. However, it also led to a significant change in the approach to social risk perception and rejecting the basic assumption, that the expert evaluation of technological risk is always right, while everything

diverging from it is a mistake resulting from irrational fears and lack of professional knowledge. Instead, social risk perception began to be treated 'seriously', as a justified expression of another perspective, based in socio-cultural rationality. Such rationality reflects rather values, needs, interests, general approach to life and future of the people, then scientific methods of technology assessment. Therefore social perception of risk should not be rejected as such, but taken into account and answered properly.

In case of smart metering we also face the problem of diverging opinions of the level of safety and character of risks related to 'smart' technologies. Starting from health risks from wireless smart meters, through security of the data collected in the system to privacy issues related to possibility of collecting, processing and combining data about behavior patterns of virtually every citizen in the system. Thus, in order to govern the risks related to smart metering, one need first to confront the issue of risks perceived by lay-people (even if they sometimes seem to be unjustified).

The sessions deals with specificity of risk perception by the public, which is mainly presented as opposed to the experts evaluations of risks. In order to prepare students for understanding why smart metering arouses social fears of different kinds, at the beginning of the session a presentation of historical cases of risk perception takes place. The characteristics of risk perception is shown in details on the example of radioactive waste management in Sweden, where a comprehensive social study has been conducted from 1980s, as a part of site selection process for final repository of radioactive waste. After that, students get acquainted with a case of Toronto city, where a company Sidewalks Labs (related to Google) plans to develop a high-tech district at the southeast of Downtown Toronto, called Quayside, using the smart metering technologies. At the end of the sessions, students are asked to identify both technical and social risks which may be perceived by the community in Toronto.

Origins and foundations of the risk perception approach

The topic of social risk perception emerged as a research subject in the 60's and 70's of the 20th century, when discrepancies between risk evaluations delivered by scientific experts and lay-people perception of risk related to new technologies became vivid, endangering the decision-making processes. The most striking example was the nuclear energy, commonly perceived by extremely dangerous, while according to expert assessments, bearing only low level of risk.

The discovery of „risk perception gap" led to developing a new field of research: psychometric risk studies. They were based on psychological risk perception studies, conducted since the 60's. A leading research center became the University of Oregon, where a.o. Paul Slovic has been working. The psychometric paradigm aimed at establishing an acceptable level of risk, i.e. to answer the question „how safe is safe enough?", to quote the famous statement from an article published in 1969 by Chauncey Starr in Science (Starr 1969). The psychometric approach was based on comparing different levels of risk people are willing to accept. E.g. if we accept a relatively high risk of accident related to driving a car, we should be willing to accept the much lower risk for health caused by using pesticides and chemical food conservatives. If the death rate in case of coal mining is higher that the death rate caused by nuclear accidents and we as society accept coal industry, we should accept nuclear energy as well.

The comparisons of risk acceptance levels were however based on the technological risk assessment procedure (R=PxH). And it quickly turned out, that in case of social risk perception it doesn't work these way. Such statements as "the annual risk from living near a nuclear power plant is equivalent to the risk of riding an extra 3 miles in an automobile" (Slovic 2000: 231) do not convince the people and do not make them accept the siting of a nuclear power plant in their neighborhood. The popular explanation of the phenomena was the differentiation between expert and social risk perception. The explanation of differences between expert and social risk perception was rooted in depreciating social rationality. The cause for lack of acceptance of new technologies, like nuclear energy or biotechnology was seen in the irrational fear of everything new, lack of scientific knowledge, lack of trust and backwardness of lay-people. Like in an enlightenment paradigm, the uneducated lay-people were set as opposed to well-educated scientists who „know the truth", while the former are simply wrong in their amateur and mistaken risk perceptions.

However, the social and psychological research on risk perception, which followed (and replaced) the psychometric approach in the 80's, has shown that such an opposition between the false social risk perception and correct expert assessments is misleading. The researchers pointed out to psychological and social factors which determine social risk perception and which are not reducible to simple irrationality and lack of knowledge. On the contrary, the social and expert risk perception are rather based in specific forms of rationality, which form the framework for risk assessments. As Terje Avon and Ortwin Renn point out, "A vast majority of studies on risk perception and concerns tend to show, however, that most of the worries are not related to blatant errors or poor judgement, but to divergent views about the tolerability of remaining uncertainty, short-term versus long-term impacts, the trustworthiness of risk regulating or managing agencies, and the experience of inequity or injustice with regard to the distribution of benefits and risks. All of these concerns are legitimate in their own right and valid for the respective policy arena. They cannot be downplayed by labelling concerns as irrational fears." (Aven, Renn 2010: 60).

An useful framework for understanding the social risk perception offers Peter Sandman, who coined the phrase that risk is the hazard + outrage factor. By 'outrage factor' he understands the character of public response to a given hazard, which is determined by various psychological and social factors and not objective, technical characteristics of a given technology or phenomena (Covello, Sandman 2001).

Dr. Peter M. Sandman

„Creator of the "Risk = Hazard + Outrage" formula for risk communication, Peter M. Sandman is one of the preeminent risk communication speakers and consultants in the United States today, and has also worked extensively in Europe, Australia, and elsewhere. His unique and effective approach to managing risk controversies has made him much in demand for other sorts of reputation management as well."
http://www.psandman.com

Research on risk perception has come to the conclusion, that in order to understand the differences between social and expert risk perception we should accept that there is no one sort of risk which is seen differently, but rather we have to deal with two various ‘risk constructions’: one is based on social, while the other on scientific rationality. In this sense, the social risk perception is not simply an ‘immature’ version of expert risk perception. These two cannot be compared, like the psychometric paradigm attempted to, since there are referring to various criteria.

Controversy over smart meters

Smart metering technology arouses much controversy in the world. From the point of view of risk perception, interesting is that different countries and communities perceives and highlights different risks. The most common issues are: security and safety (cyberattacks and power outages, possible fires), privacy (collecting data and selling them to third parties, surveillance, legal issues), health (impact of wireless data transmission on the body), opt-out (coercion), finance (cost of device and its infrastructure, increasing cost of electricity). Among the many different initiatives against smart metering, there is established in 2010 website stopsmartmeters.org, which grew out of a grassroots initiative and which focuses on supporting various local movements. This initiative has contributed to several legal precedents, which resulted in the mass removal of smart metering devices in some states (US). In 2013 was released a documentary film Take Back Your Power, which sharply criticized the legitimacy of setting up smart meters. It focused mainly on issues related to the security of collecting data and its use by the state and third parties. Many of doubts about smart metering are not justified by scientific research, but from the point of view of risk perception, it is not important whether any threat is real or not, and on the basis of which criteria to decide on it. If people perceive something as a threat, the consequences of their behavior are real and unquestionable.

CASE STUDY: Toronto

At the beginning of 2017 Toronto decided to develop a post-industrial waterfront area. In addition to the municipal authorities, this area was taken care of by a grassroots initiative called „Waterfront Toronto”. Google’s daughter company, Sidewalk Labs, decided to build a city of the future here. Although the final decision was taken at national and city level, it was immediately stipulated that Waterfront Toronto would be heavily involved in the decision-making process. The plans immediately aroused many different controversies among different social groups. The most frequently raised problem turned out to be the collection of data by intelligent metering devices. The company conducts meetings with residents, has created an editable online document in which everyone can express their concerns and ask questions, to which the company is obliged to answer.

An example of building a city of the future on the Toronto’s waterfront was chosen because it is an ideal example, including of local residents (grassroots initiatives, professors, ordinary citizens, etc.) to co-decide on the technologies used, technical solutions and the applicable legal principles.

CASE STUDY: Siting of a deep nuclear waste repository in Sweden

The storage of radioactive waste is one of the most important challenges facing humanity in the 21st century. Different countries apply not only different technological solutions, but also different ways of selecting a storage site and, consequently, different ways of dealing with the local community. The example of Sweden was chosen because it is often presented as a model to follow.

The first commercial nuclear power plant in Sweden started work in 1975. In 1977 Sweden introduced a law that required accurate documentation of the absolutely safe storage of nuclear waste. In 1984 this law was updated, adding the requirement that plant owners must submit a „comprehensive research and development programme" for the storage of nuclear waste. SKB (Svensk Kärnbränslehantering AB) became the company that was set up to manage nuclear waste. The Swedish company initially focused only on the scientific dimension of the problem. In the 1980s, the SKB started to drill test boreholes all over the country, which I met with great resistance from local residents. The protests of local residents led to the cessation of drilling. The company came to the conclusion that without the consent of local residents, the implementation of any solution will be impossible. The company changed its strategy in the 1990s and began to conduct extensive public consultations.

Strategy of in-depth public consultations, in which local residents have the opportunity not only to learn many things, but also to express their concerns, their voice is respected and has real decision-making significance, has its drawbacks. It is a long-term process that requires competence from outside hard science. The choice of a radioactive waste disposal site required a skillful combination of social sciences, humanities and a range of natural sciences. The consultation and selection of the final place ended in 2007. Although the strategy was time-consuming, the result brought many benefits. Local residents have raised their awareness of radioactive waste, have a sense of co-determination on important national projects, and the company has succeeded in addressing technical issues related to the storage of radioactive waste.

SKB

Svensk Kärnbränslehantering AB

c) Pre-reading

No.	Author and title	Description
1.	Ropeik, David. Understanding Factors of Risk Perception. „Nieman Reports" 2002, Vol. 56, Issue 4, pp. 52. Code: TM-ST2-AM5-FactorsOfRiskPerception	Basic list of risk perception factors.
2.	Risk Perception https://www.youtube.com/watch?v=dNgrKQo0gMg	Course Risk in Modern Society conducted at Ledien University. Module: Risk Perception
3.	Berggren, Marie, Rolf Persson. Public Involvement and Participation in Site Selection for Spent Nuclear Waste in Sweden. 2014, WM2014 Conference (post conference paper). Code: TM-ST2-AM8	Post-conference paper: Berggen, Marie, Persson, Rolf. 2014. "Public Involvement and Participation in Site Selection for Spent Nuclear Waste in Sweden".
4.	Final repository for spent nuclear fuel https://www.youtube.com/watch?v=WCHqxqlZUNA	Video about technological aspects of storage of nuclear waste.
5.	Is your smart meter spying on you? Code: TM-ST2-AM9	Newspaper article on dangers of smart meters.
6.	Covello, Vincent, Peter M. Sandman. 2001. Risk communication: Evolution and Revolution. In: Anthony Wolbarst (ed.), Solutions to an Environment in Peril. Baltimore: John Hopkins University Press, pp. 164–178. Code: TM-ST2-AM7-RiskCommunication	Article on the history of risk communication, discussing the basic issues and difficulties related to it.
7.	Public Draft Code: TM-ST2-AM4-TorontoCasePublicDraft	A bottom-up public opinion project in which anyone interested could ask a question. The file contains over 100 questions divided into several thematic groups. It is to be used as a teaching aid for the teacher.

d) Session activities

Activity 1:
Risk identification exercise

Methods	Presentation
Keynotes	Students should only focus on presenting their findings without prolonged comments.
Materials	**None**
Required accessories	whiteboard, markers
Time allocation	20 min
Learning outcomes	Students can identify risks appearing in public discourse on smart metering.

Students briefly list the identified risks. Teacher writes them down on the board. After the list is completed, students are asked to indicate which risks they think to be real and which are not.

It is important that the teacher abstains from commenting and does not enable discussion on it. It will come later with and after the introductory presentation. Thus, the list of the risks should stay visible for the next part of the session.

Activity 2:
Introductory presentation

Methods	Direct presentation
Keynotes	Alert the students to a great variety of potential risks.
Materials	**SM-ST2-RM1 Risk Perception**
Required accessories	None
Time allocation	20 min
Learning outcomes	Students are aware of the broad context of technological risk perception, understand its backgrounds and conditions.

This activity has an introductory character and consists of a concise presentation. It delivers basic concepts in risk perception and presents history of psychometrical and sociological research on the topic. As illustration for the presented concepts the example of Swedish radioactive waste management debate is used.

Activity 3:
Technical and social risks identification

Methods	Project based analysis, work in groups, discussion, assessment
Keynotes	Students should focus not only on finding but also on classifying and grouping risk.
Materials	**SM-ST2-RM2-TorontoCase Presentation** **SM-ST2-RM3-TorontoCase** **SM-ST2-RM4-TorontoCase** **SM-ST2-RM5-TorontoCase** **SM-ST2-RM6-TorontoCase** **SM-ST2-RM7-TorontoCase** **SM-ST2-RM8-TorontoCase** **SM-ST2-RM9-TorontoCase** **SM-ST2-RM10-TorontoCase** **SM-ST2-RM11-TorontoCase** **SM-ST2-RM12-TorontoCase** **SM-ST2-RM13-TorontoCase** **SM-ST2-RM14-TorontoCase** **SM-ST2-RM15-TorontoCase** **SM-ST2-RM16-TorontoCase** **SM-ST2-RM17-TorontoCase**
Required accessories	flip charts, markers
Time allocation	55 min
Learning outcomes	Students can identify technical risks related to smart meters.

Students are divided into two groups and given various materials (press articles, webpages' printouts etc.) about the case, they should discuss and try to identify technical and social risks. Students should try to group together the different risks and find links between their different types. Then, groups present shortly (approximately 5-10 minutes per group) the identified risks (it can be done using flip charts). At the end, the results of the activity are evaluated together with the teacher.

Social risks example outcome:

- Who will own/control/have access to the data that is captured by the sensors deployed in this project?
- Under what terms will that data be shared? For whom and for what purposes?
- Who will be trained to operate, control, maintain proprietary systems used throughout this project?
- Who will be responsible to respond should project infrastructure be hacked?
- How will sustainability design elements be prioritized – low carbon, cost savings, comfort of residents?
- How will public feedback and feedforward be incorporated into design and implementation?
- Do residents have a right to opt-out of the systems? Do they have, or can they claim, a right to be forgotten if data is collected about them?

Activity 4: Risk map

Methods	Mind map, discussion
Keynotes	This task is best done on a whiteboard.
Materials	**None**
Required accessories	white board, white board pens (in different colors), colored cards needed to build a risk map
Time allocation	20 min
Learning outcomes	Students can see connection between various kinds of perceived risks and ascribe them to different social actors (stakeholders).

Both technical and social risks identified in activities 2 and 3 are now ordered and structured in a 'risk map'. Teacher together with the students looks for connections and relations between different kind of risks in order to group them together as they appear in public discourse. Teacher and students aim at describing which risks are connected with each other, which ones usually appear together, which ones are mutually exclusive. The results of the discussion are directly written on the white board. Afterwards, students are asked to identify social actors (individuals, institutions, social groups, private and public bodies) which share the perceived branches of risk.

Activity 5:
Summary discussion

Methods	Discussion
Keynotes	The discussion should be guided to discover the necessity of proper risk communication.
Materials	**None**
Required accessories	**None**
Time allocation	20 min
Learning outcomes	Students can take the perspective of various stakeholders and perceive risks related to smart metering from their point of view.

Final discussion serves summing up the session. During the discussion natural differences between perspectives of various stakeholders should be stressed. The session should be concluding by asking the practical question how to deal with the differences and how to take decisions on controversial technologies when they are so diverging opinions of them. This question is a platform to the next session.

e) Additional resources

No.	Author and title	Description
1.	Smart attack! https://youtu.be/N29AtA3VodU	Short video: Smart attack!
2.	Take back your power! https://takebackyourpower.net/watch-take-back-your-power-2017/	Documentary movie: Take back your power!
3.	Stop Smart Meters! https://stopsmartmeters.org/	The most popular website gathering opponents of smart metering.
4.	Smart electricity meters can be dangerously insecure, warns expert https://www.theguardian.com/technology/2016/dec/29/smart-electricity-meters-dangerously-insecure-hackers	Article on the threats of hacking smart meters.
5.	FBI: Smart Meter Hacks Likely to Spread Code: TM-ST2-AM10	Article in cyber intelligence bulletin in which FBI warns against the spread of smart meters hacking.
6.	Smart meter hacking can disclose which TV shows and movies you watch Code: TM-ST2-AM11	Article about how smart metering can put our privacy at risk.
7.	Smart Hacking for Privacy https://www.youtube.com/watch?v=YYe4SwQn2GE&feature=youtu.be	Speech at the conference on smart meters hacking.
8.	Google Partners with Eight Utilities in Smarteter Projects to Track Energy Use Online Code: TM-ST2-AM12	Article on Google's plans for online tracking of consumption of energy.

Session 3:
Risk communication

a) Session objectives

The goal of the session is to introduce the next step of the risk governance framework, namely the risk communication approach. In this session students should learn to identify advantages and disadvantages of each model of communication and choose the most appropriate one in case of smart metering.

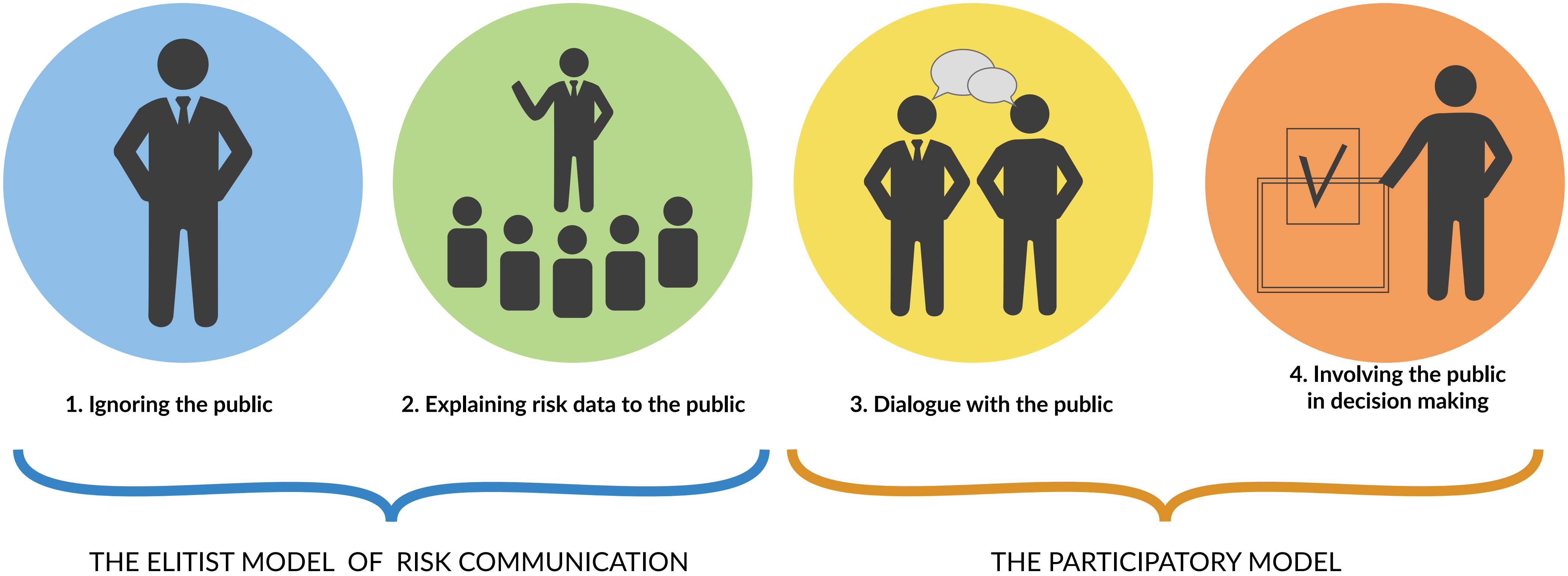
b) Session scope

Risk communication deals primarily with the question how to talk with the interested parties about the controversial technology. Approaches in risk communication reflect to a high degree the position taken previously on risk perception. If we assume that lay-people are simply wrong because of their irrational fears and lack of knowledge, the most probable risk communication strategy is aimed at convincing them that they are wrong and deliver them 'correct' knowledge by the experts. This approach has become famous as the so-called 'deficit model', what refers to the deficit of knowledge as an assumed source of flawed risk perception. If, again, we accept the diverging opinions on risk in the society, 'dialogue model' of risk communications comes into play. It is based on the recognition of different actors taking part in the debate, each of them having different needs and interest, representing various cultural values, traditions, norm, having diversified visions of future. Therefore, the spectrum of risk communication stretches from approach based on convincing and educating people to including them into dialogue and cooperation.

Using the deficit and dialogue model of risk communication, within this sessions students are confronted with different approaches to communication with the public on the matter of smart metering. As first comes a general introduction, where the conceptual framework is presented, illustrated by two cases of deficit and dialogue approach respectively. Afterwards, the framework has to be adapted to the previously introduced Toronto case and students have to choose the most effective risk communication approach. At the end, a 'Court roleplaying game' is conducted, and the students divided into two groups have to defend one of the approaches.

Models of risk communication

The history of risk communication, closely related to the developments in research on social risk perception, can be described in four stages (Covello, Sandman 2001):



The elitist model of risk communication

This model, also called technocratic, top-down, hierarchic, expert-based, managerial is based on a well described „deficit model of public understanding of science". Its basic assumptions say that most people lack the knowledge needed for proper evaluation of complex technological phenomena and risks related to them. Therefore, the lack („deficit") of knowledge is perceived as the main problem.

What's next, delivering scientific knowledge by experts is seen as the most efficient strategy of risk communication. Expert knowledge and rationality is perceived as superior to the social perception of risk, which has to be corrected.

The participatory model

The participatory model, in turn, results from acknowledging the specificity of social risk perception and doesn't place it in opposition to expert risk assessment. It is based on values of dialogue, inclusiveness, engagement of the public and open deliberation. Stages three and four of risk communication (dialogue with the public and including of the public) are the best known expressions of this model.

Based on these two models, two opposite risk communication strategies can be named:

DAD strategy

(Decide-Anounce-Defend) based on the elitist model and used in stages one and two. Starting from taking a decision by the experts and limiting the risk communication to one-way flow of information to the public, focusing on defending the decision taken, it often ends up in the necessity to abandon the decision (hence DADA). It is not only based on false assumptions about the risk perception, but also on ineffective methods of communication. This strategy works well only in case of emergency situation and/or where there are no controversies about the decision to be taken. In case of diverging opinions and risk assessments, when many social, cultural and political values are at stakes, the strategy usually fails.

ADD strategy

(Announce, Discuss, Decide), based on participatory model of risk communication. The decision is preceded with dialogue with the public (social partners, stakeholders). This strategy is commonly perceived as more effective in case of controversial energy investments.

Żurawlów case study - example of unfavorable practices of risk communication

In 2012 the Polish government, in agreement with the American company Chevron and with the positive opinion from scientists, decided to extract shale gas in Poland in a small village called Żurawlów. It was a top-down initiative, without consulting local residents. Some consultations took place after the introduction of heavy equipment on the drilling site. However, they were purely informative and the opinion of the inhabitants was not taken into account.

The local community turned out to be very well organized and concerned with the common fate of the village. It blocked the area and organized 24/7 patrols to ensure that heavy equipment does not enter the drilling site. It had the support of communities from other countries who were in a similar situation. Ultimately, after 400 days of occupation, Chevron abandoned shale gas production in Żurawlów. Lack of public consultations and failure to take the voice of the residents seriously caused the project to fail. The Żurawlów case became a handbook example of a failed DAD strategy.

source: www.facebook.com/OccupyChevronPL

c) Pre-reading

No.	Author and title	Description
1.	Fischhoff, Baruch, John Kadvany. 2011. Risk Communication. In: Risk: A Very Short Introduction. New York: Oxford University Press.	Chapter introducing the issue of risk communication.
2.	Fischhoff, Baruch. Risk Perception and Communication Unplugged: Twenty Years of Process. „Risk Analysis" 1995, Vol. 15, Issue 2, pp. 137-145. DOI: 10.1111/j.1539-6924.1995.tb00308.x	Historical outline of risk perception and communication.
3.	Poland's shale gas revolution evaporates in face of environmental protests Code: SM-ST3-R1-Zurawlow	Article on protests in Żurawlów.
4.	Palasz, Pawel. Cleantech Poland. Code: SM-ST3-AM2-Zurawlow	Article on protests in Żurawlów.
5.	Site investigation Forsmark 2002-2007, pp. 5-12. Code: SM-ST3-AM1-Forsmark	Information on the difficulty of finding a storage site for radioactive waste by SKB.
6.	Decide Announce & Defend Code: SM-ST3-AM3	Article on disadvantages of DAD approach to risk management.
7.	The evolution of public understanding of science - discourse and comparative evidence Code: SM-ST3-AM4	The article, the first part of which deals with the historical development of public understanding of science.

d) Session activities

Activity 1:
Introduction to risk communication

Methods	Lecture
Keynotes	None of the communication methods should be pointed out as better than the other.
Materials	**SM-ST3-RM1- Risk Communication**
Required accessories	None
Time allocation	25 min
Learning outcomes	Basic understanding of risk communication

The activity consists of an introductory presentation on two opposite approaches in risk communication: deficit model and dialogue approach, known also as DAD strategy (decide-announce-defend) and ADD strategy (announce-discuss-decide). Both styles of communicating with the public are then illustrated using examples of a 'good practice' and a 'bad practice' in risk communication. The first approach will be presented on the example of radioactive waste disposal in Sweden by SKB. The second approach will be presented on the example of shale gas extraction in the Polish town of Żurawlów. Social consequences of adopting both models are shown, using the context of investment siting literature.

Activity 2:
Risk simulation analysis

Methods	Project based analysis, discussion, assessment
Keynotes	Students should focus mainly on identifying communication methods.
Materials	**SM-ST2-RM2-TorontoCase** **SM-ST2-RM3-TorontoCase** **SM-ST2-RM4-TorontoCase** **SM-ST2-RM5-TorontoCase** **SM-ST2-RM6-TorontoCase** **SM-ST2-RM7-TorontoCase** **SM-ST2-RM8-TorontoCase** **SM-ST2-RM9-TorontoCase** **SM-ST2-RM10-TorontoCase** **SM-ST2-RM11-TorontoCase** **SM-ST2-RM12-TorontoCase** **SM-ST2-RM13-TorontoCase**
Required accessories	flip charts, markers, writing paper in various colors
Time allocation	35 min
Learning outcomes	Understanding of communication approaches

The goal of this activity is to use the knowledge from Activity 1 on different approaches to risk communication to the Toronto case. Students are reminded shortly by the teacher about the case and given selected materials regarding the case. Then, working in groups, they have two tasks: first, to describe and identify characteristics of the communication strategy actually used in the Toronto case, and then to evaluate it and – if needed – propose a better one.

Activity 3:
Court roleplaying game

Methods	Court roleplaying game
Keynotes	It is important to select an active student as the judge.
Materials	**TM6-ST3-RM14 – Court roleplaying materials**
Required accessories	Sheets of paper
Time allocation	75 min
Learning outcomes	Understanding of communication methods application

The aim of this activity is for the students to practice the understanding of DAD and ADD risk communication methods. The students are asked to play out a court roleplaying game. The immediate purpose of the game is to select the method which is better from the point of view of the students. The rules of the roleplay are described in TM6-ST3-RM14.

It is suggested that the number of arguments presented in favor of each method (DAD vs. ADD) should not exceed 5 (students should decide to choose 5 arguments out of the pool of arguments discussed in groups). It is proposed that the arguments are distributed among students so that each reason is presented by another group member.

e) Additional resources

No.	Author and title	Description
1.	Consultation for final disposal of spent nuclear fuel http://www.skb.com/future-projects/the-spent-fuel-repository/our applications/consultation-for-final-disposal-of-spent-nuclear-fuel/	Annual reports on consultations conducted by the SKB.
2.	Sidewalk Labs Advisory Council - Meeting 1 Summary https://sidewalktoronto.ca/wp-content/uploads/2019/01/Sidewalk-Labs-Advisory-Council-Meeting-1-Summary.pdf	Labs advisory council' meeting with the citizens of Toronto and various organizations.
3.	Covello, Vincent, Peter M. Sandman. 2001. Risk communication: Evalution and Revolution. In: Anthony Wolbarst (ed.). Solutions to an Environment in Peril. Baltimore: John Hopkins University Press.	A chapter in the book about the history of risk communication, its most important aspects, as well as seven cardinal tips on how to communicate about risk.

Session 4: Risk management

a) Session objectives

Students get knowledge about possible strategies in risk management, based on the criteria of various kinds of risk. They learn to assess which strategy is required and how to plan its realization.

b) Session scope

Risk management comes as the last and final part of each risk governance process. It encompasses the ultimate moment of decision making on the risk issue, thus is crucial for the whole approach. The question ‘how to deal with risk’ is answered within this approach depending of the kind of risk. One of the most widespread and popular classification of different kinds or risk and respective ‘risk discourses’ is the model adapted by International Risk Governance Council.

It distinguishes four kinds of risks (Renn 2008: 178-180; Aven, Renn 2010: 183-185):

Simple (routine) risk and instrumental risk discourse

Simple risks are those with low complexity, uncertainty and ambiguity. In other words, these are known, calculable and relatively easy to manage risks with established regulatory procedures. Examples include car accidents, smoking, regular natural disasters, building constructions risks. The assessment of simple risks is not controversial and does not differ significantly between various social groups.

Complex risk and epistemic discourse

Complex risks are those where identifying and quantifying causal links is not so easy as in case of simple risks. Long delay periods between cause and effects, a multitude of intervening variables but also the lack of sufficient knowledge and scientific methods belong to the main obstacles. “The global decrease in biodiversity is an example of a risk situation that is characterized by high complexity. The destruction of natural habits of endangered species, the intrusion of invasive species caused by globalized transport and travels, and environmental pollution are only some influencing factors, of which the interdependencies are unknown to a large extent.” [Aven, Renn 2010: 12].

Unknown risk and reflexive discourse

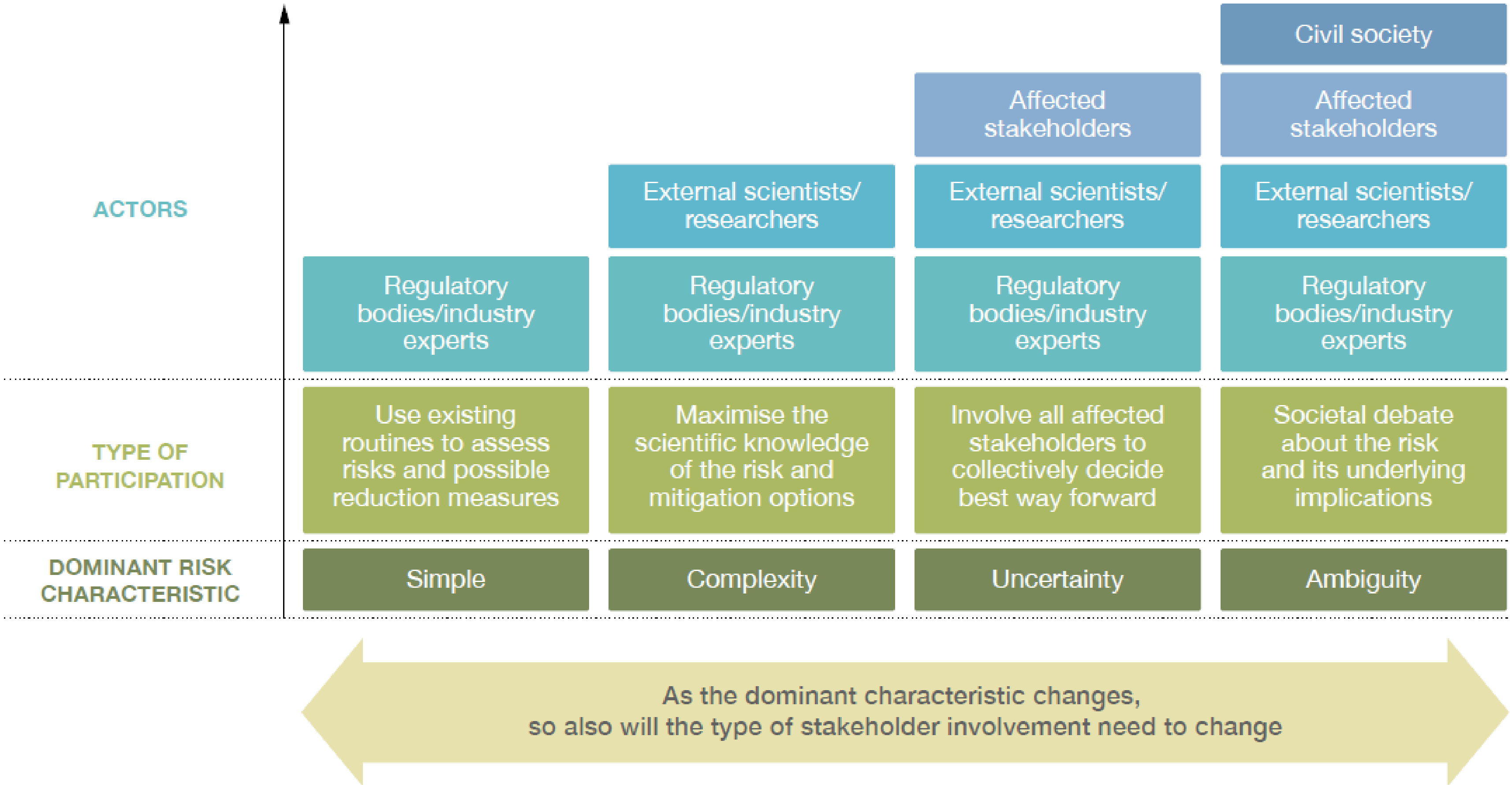
Uncertain risks are caused by a difficulty of predicting the occurrence of an event and/or its consequences. It refers to the classical risk definition as probability of occurrence of a harmful effect. Examples are natural disasters (such as earthquakes), possible health effects of mass pollutants or consequences of introducing genetically modified species into environment.

Ambivalent risk and participatory discourse

Ambiguity refers to different ways of interpreting the level and character of risk, both in technical and in normative terms. Ambiguity in risk disputes is a public phenomenon, appearing as a result of concerns what an advancement of a given technology means for human health, environment, social life etc. Such ambivalent technologies are e.g. low dose radiation, food supplements, nuclear power, pre-natal genetic screening.

This categorization comes from the Risk Governance Framework promoted by International Risk Governance Framework (see IRGC 2017). This approach is based on the idea, that the more uncertainty and disagreement about possible consequences of a technology exist, the bigger the required engagement of the public should be (see IRGC 2017: 17-19) . Therefore, each of the four types of risk requires a different risk management strategy, which differ from each other by the scale of public engagement (IRGC 2017: 23-25, 29-31).

In case of simple risk, an instrumental routine-based procedures of regulatory bodies and agencies are usually enough. Complex risk require risk-informed and robustness-focused strategy, stemming from scientific discourse led by experts from various disciplines. Uncertain risks should be managed using precaution-based strategies (like the precautionary principle in EU law) and include relevant stakeholders (local communities, NGOs, business actors, consumers groups). The broadest inclusion of the public takes place in case of ambivalent risks, where a public debate with civil society is required.



The choice of an appropriate risk management strategy depends thus on the kind of risk (and its complexness) that is being dealt with. They stretch out from purely expert decision making procedures to broad public debates based on involvement of different stakeholders. As we can see, risk management discourses reflect therefore the previously presented variety of risk perception and communication approaches. Depending of the level of uncertainty and importance of values at stake, various levels of public participation are required.

‘GM Nation?’ debate – case study

Within this session the concepts of risk management with its four risk discourses are adapted to smart meters. After presenting main approaches within the risk management field, a case study of British “GM Nation?” public debate on genetically modified food is discussed. Afterwards, attention is put to smart meters, in order to assign the appropriate kind of risk to the issue and then the respective risk discourse.

The issue of genetically modified food is an important global problem. Genetically modified food is a controversial issue, mainly with regard to its impact on health. Different countries are trying to deal with it in different ways. The example of GM Nation was chosen because it is one of the largest risk management projects based on the inclusion of citizens in the debate. In July 2002, the UK government launched a nationwide debate on GM crops and foods – GM Nation. NGOs, scientists, grass-roots initiatives, companies and ordinary citizens were to take part in the debate. The aim was to produce an opinion, including a public opinion, in order to be able to develop national policies on GMs. Although the debate did not produce the expected results, in the form of unanimous attitudes and decisions, it was an important lesson, showing that involving the general public in the risk management process not only makes sense, but is necessary.

c) Pre-reading

No.	Author and title	Description
1.	GM: the GM Nation Review https://www.youtube.com/watch?v=Jd2uD0V3h7I https://www.youtube.com/watch?v=NMDOWP1fOXs	Two (of four) films commenting on GM controversies in the UK from The Open University.
2.	Introduction to the IRGC risk governance framework Code: SM-ST4-AM6	Comprehensive risk governance framework developed by International Risk Governance Council.
3.	GM Nation? Debate GM Debate: Dispelling myths Code: SM-ST4-AM1-GMNATION	Two short comments from Nature journal on the GM Nation debate.
4.	GM Debate: No trust, no go! Code: SM-ST4-AM2-GMNATION	Short article from Heredity journal on the GM Nation debate
5.	GM nation? Public debate: a valuable experiment Code: SM-ST4-AM3-GMNATION	News about the value of the public debate around GM Nation
6.	British public Code: SM-ST4-AM4-GMNATION	Short newspaper article summarising a report by a non-governmental organisation expressing concerns about some of the gaps in the ongoing debate
7.	The GM public debate: context and communication strategies Code: SM-ST4-AM5-GMNATION	Article analysing the way of communicating risk on the example of GM Nation

d) Session activities

Activity 1:
Introduction to risk communication

Methods	Lecture, discussion
Keynotes	The key of this activity is the description of the risk governance framework.
Materials	**SM-ST4-RM1-Risk management**
Required accessories	None
Time allocation	25 min
Learning outcomes	Knowledge on the IRGC scheme and four types of risk discourses

Based on the results of the court roleplaying game from session 3, the concept of IRGC risk management is presented. As a starting point, a case of UK 'GM Nation?' debate is introduced.

Four types of risk discourses are introduced and then within a discussion with the students applied to risks related to smart metering. Students try to answer the question, which strategy would be the most appropriate to effectively manage the SM? Which kind of risk does SM represent? Where do other known examples of controversial technologies fit?

Activity 2:
Risk simulation analysis

Methods	Group work, workshop
Keynotes	It is the final assignment of the module.
Materials	**TM6-ST4-RM2-risk simulation analysis materials**
Required accessories	None
Time allocation	80 min
Learning outcomes	Knowledge of risk governance framework

This activity sums up the whole course, putting all the three parts – risk perception, communication and management – into one. Students are asked to analyze the given cases based on the knowledge and skills gained in the previous session. Once complete, Students present their risk simulation analysis results.

Activity 3:
Module summary discussion

Methods	Discussion
Keynotes	It is a good idea to repeat the most important points of all four sessions.
Materials	**None**
Required accessories	None
Time allocation	30 min
Learning outcomes	Knowledge of risk governance framework

This summary discussions aim is to facilitate the students understanding of risk perception, risk communication and risk governance. The students should be again lead to the idea that a given subject matter can be perceived in terms of risks differently by groups and individuals with taking into account the correctness of each perceived risk.

e) Additional resources

No.	Author and title	Description
1.	GM: The UK Debate - Politics https://www.youtube.com/watch?v=d8gDVDbsETA https://www.youtube.com/watch?v=d8NyuILCVKc	The other two films (the first and the second can be found in pre-readings) on GM Nation's national debate in the United Kingdom.
2.	GeneWatch UK Code: SM-ST4-AM7	GeneWatch UK report on the conduct of the UK's public debate on GM crops and food.
3.	Fra Paleo, Urbano (ed). 2015. Risk Governance. The Articulation of Hazard, Politics and Ecology. Springer: The Netherlands.	Collection of texts on different perspectives and applications of risk governance
4.	Renn, Ortwin, Andreas Klinke, Marjolein van Asselt. Coping with Complexity, Uncertainty and Ambiguity in Risk Governance: A Synthesis. "Ambio" 2011, Vol. 40, Issue 2, pp. 231-246.	In-depth analysis of the concept of the idea of risk governance.
5.	Van Zoonen, Liesbet. Privacy concerns in smart cities. „Government Information Quarterly" 2016, V ol. 33, Issue 3, pp. 472-480.	Article dealing with the issue of privacy in the context of data collection in smart cities.
6.	Mengolini, Anna, Julija Vasiljevska. 2013. The social dimension of Smart Grids. Consumer, community, society. JRC Scientific and Policy Reports. https://ec.europa.eu/jrc/en/publication/eur-scientific-and-technical-research-reports/social-dimension-smart-grids-consumer-community-society	Report of the European Union Committee of Energy and Transport.

Assessment methods and final assignment

Session 4 includes the final assignment in which the students are asked to apply all gained skills and knowledge in a risk simulation analysis and present the results. Criteria to be taken into account:

– proper identification and classification of risks
– adequate understanding and application of risk communication methods
– correlation of risks and risk communication methods in the risk governance framework

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the coruse.

- identification of possibilities to go further: related courses, topics, disciplines.

Glossary

AMI	stands for "Advanced Metering Infrastructure".
Technology assessment	a scientific, interactive, and communicative process that aims to contribute to the formation of public and political opinion on societal aspects of science and technology.
TOU	stands for "time of use" (related to the time of being used).
Grid	refers to the electric grid: a network of power generators, transmission lines, substations, transformers and other devices delivering electricity from power plants to our homes or businesses.
EVCS	stands for "Electrical Vehicle Charging Station".
IoT	stands for "Internet of Things". It is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.

MDMS	stands for "Meter Data Management System" which utility centers use to function. One of their uses is billing of end-users energy use.
RF	stands for "Radio Frequency". It is a term used to describe wireless radio data transmission.
PLC	stands for "Power Line Carrier". It is a term used to describe transmission of data thru power lines.
FCC	is stands for Federal Communications Commission (U.S. federal agency responsible for implementing and enforcing communications law and regulations).
CEN	stands for European Committee for Standardization.
CENELEC	stands for European Committee for Electrotechnical Standardization.
ETSI	stands for European Telecommunications Standards Institute.
NIST	stands for National Institute of Standards and Technology (U.S. Department of Commerce physical science laboratories and standardization organization).
Risk perception	applies to different perceptions of risk. There are two main approaches to risk assessment: – Technological risk: risk = probability x harm – Social risk perception: based in socio-cultural rationality. Such rationality reflects rather values, needs, interests, general approach to life and future of the people, then scientific methods of technology assessment
Risk communication	refers to the communication strategy between the parties when applying technology to the society. The communication strategy depends to a large extent on the concept of risk perception. There are two basic models of risk communication: – DAD(A): Decide – Announce – Defend (- Abandon) The model is based on a simple technological risk perspective, in which experts, on the basis of their knowledge, try to implement a technology, and contacting with society only if they meet resistance from them. – ADD: Announce – Discuss – Decide It is the strategy based on social perception of risk, in which the decision to implement a technology is made together by experts and the public.
Risk management	Risk management is a way of identifying, assessing, prioritizing and choosing ways of coping with risks at different levels (economic, technological, security, social, etc.). The risk management strategy varies according to the type of risk, which could be divided on: simple, complex, uncertain and ambivalent.

Attachment: Syllabus

1. Name of the Teaching Module

Smart metering. Social risk perception and risk governance

2. Brief description of the subject matter

The goal of this TM is to broaden the understanding of technology-related risks and present the concept of risk governance in the context of smart metering technologies.

In current phase of technological development – known as the Fourth Industrial Revolution – rapid and profound changes are likely to set up new and particularly destabilizing risks. In more and more complex technological systems that constitute modern life, the risks become difficult to identify and even more difficult to measure and manage. Many of the technologies, such as artificial intelligence (AI) or genetically modified organisms (GMO) are considered from this point of view. A demonstrative example from the energy sector is smart metering (SM) technology.

Smart metering means employing communication technologies to exchange information between electric utilities and their customers, and sensing technologies to constantly measure the quantity and quality of electricity being transferred over the grid, which is thus called the Smart Grid. Smart Grids are complex systems comprising numerous interconnected components – controls, computers, measuring devices, and other digital equipment, as well as advanced software and applications – working together and exchanging information.

In such complex systems one can point to relatively isolated technological risks, such as for example the risk of a cyberattack interrupting supply of electricity. However, in an increasingly interconnected world the consequences of such risks – technical, social and political ones – can be of much greater importance.

In order to make students aware how our assumptions and perceptions shape our attitude towards technology-related risks, the theory and practice of risk governance approach is presented and explained.

3. Complete SSH problems description

Stimulation of Smart Grids into energy consumer market increases social awareness not only of modern technological advancements (such as availability of RES / energy prosumption in households, integration with IoT etc.), but also of significant social, technical and political threats that are expected to emerge. In general, all three groups of threats are understood to interrelatedly form risks related to privacy issues.

The risks result directly from the basic technical concept and characteristics and of Smart Grids and foremost include the following dangers:

- the “big brother” effect,
- security of big data systems,
- misuse of consumer personal data.

It is important to stress that efficient dealing with the risk concerns is possible not only on social site (by introduction of suitable regulatory systems) but also within the technical design of Smart Grids (by development of adequate/riskless solutions).

Subsequently, rise of Smart Grids “new technology risks” will certainly require solving at least the following problems:

- risks perception, communication and social acceptability,
- risks assessment, management and minimization.

The above dilemmas call for proper governance and maintenance of Smart Grids, under which one should understand not only technical tasks of big data management, but also political process of implementing many sociotechnical innovations. Staring from who should decide on the crucial logistical choices, who and how should govern the consumer data, going to how should the innovation be integrated into the community – all these aspects are just previews of numerous SSH dimensions to be considered. Without proper technical solutions, regulatory institutions and social awareness, the existing and growing image of Smart Grids can be significantly harmed.

4. Learning outcomes

1) Knowledge

- basic assumptions of risk governance approach
- different development stages and approaches to social perception of risk, risk communication and management;
- crucial examples of dealing with controversial technological innovations.

2) Skills

- application of risk governance scheme to controversial technologies
- understanding different perceptions of risk in the society
- explaining differences in risk perception
- designing appropriate risk communication & management strategies

3) Social competencies

- team work
- finding consensus in a group in a context of strongly variating attitudes
- understanding others' positions
- formulating arguments for one's own opinion.

5. Form of classes

- Lecture, seminars with presentations, group work and workshops
- Four sessions (3x45min) for up to 20 students.
- At least 70% direct student participation.
- Additional self-study in-between stages 1-2, 2-3, 3-4.

6. Teaching methods

- Concept problem presentation (power point) with brainstorming, discussion.
- Student project with Webquest, case study, analysis
- Workshops

7. General classes plan

Session 1. Smart Grids and Smart Meters (3x45min)

1) An introductory open-form (with student interaction) lecture on Smart Grids with stress on the representative example of Intelligent Energy Meters.
2) Presentation and discussion of energy consumption data for end-users with indications of data gathering methods.
3) Consumer energy data calculations for different scenarios
4) Discussion with students of their understanding of data management.

Session 2. Risk perception (2x60min)

1) Before the classes, the students were asked to find on their own materials concerning technical and non-technical risks related to smart metering. They will have to classify the risks as real and unreal based on the information they have gathered in the classroom.
2) Introductory presentation on risk perception based on a case study (radioactive waste disposal in Sweden).
3) Identification of technical and social risks based on case study materials ("Toronto" case) a) Are there risks? b) verification based on real materials
4) Summary discussion in which students should focus on the differences between stakeholders. The teacher should ask questions about the practical consequences of social risks, about specific decisions and controversies. This activity is an introduction to the next session.

Session 3. Risk communication (3x45min)

1) Presentation on risk communication with illustrations of different communication strategies (deficit model vs. participatory model).
2) Analysis of risk communication in the "Toronto" case.
3) Court role playing game, two approaches (case study): (1) deficit model of communication, (2) participatory approach are presented and defended.
4) Students are asked to study before the next session materials on a case of UK's 'GM Nation?' debate

Session 4. Risk management (3x45min)

1) Introductory summary of risk discourses, included example of "GM Nation".
2) Final assignment: Risk simulation analysis
3) Conclusion: risk governance framework discussion

8. TM assessment methods & criteria

Session 4 includes the final assignment in which the students are asked to apply all gained skills and knowledge in a risk simulation analysis and present the results. Criteria to be taken into account:

- proper identification and classification of risks
- adequate understanding and application of risk communication methods
- correlation of risks and risk communication methods in the risk governance framework

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the module.

9. Additional literature and other materials

Literature:

1. Smart Metering

1.1. Wranga, Kasun et al. 2014. Smart metering. Desing and Applications. Singapore: Springer- Verlag.

2. Smart City

2.1. Mahmood, Zaigham (ed.). 2018. Smart Cities: Development and Governance Frameworks. Switzerland: Springer.

2.2. Papa, Rocco, Fistola Romano (eds.). 2016. Smart Energy in the Smart City. Urban Planning for Sustainable Future. Switzerland: Springer.

3. Risk Perception

3.1. Starr, Chauncey. Social Benefits versus Technological Risk. „Science" 1969, Vol. 165, Issue 3899, pp. 1232-1238.

3.2. Slovic, Paul. 2000. The Perception of Risk. In: Slovic (ed.). The Perception of Risk. Earthscan Publications, London-Washington.

3.3. Aven, Terje, Ortwin Renn. 2010. Risk Management and Governance. Concepts, Guidelines and Applications. Springer

4. Risk communication:

4.1. Fischhoff, Baruch, John Kadvany. 2011. Risk. A Very Short Introduction. New York: Oxford University Press.

4.2. Covello, Vincent, Peter M. Sandman. 2001. Risk communication: Evalution and Revolution. In: Anthony Wolbarst (ed.). Solutions to an Environment in Peril. Baltimore: John Hopkins University Press.

5. Risk management

5.1. Aven, Terje, Enrico Zio (eds.). 2018. Knowledge in Risk Assessment and Management. Chichester: John Wiley&Sons.

5.2. Drobinski, Philippe et al. (eds.). 2017. Renewable Energy: Forecasting and Risk Management. Paris: Springer.

5.3. Renn, Ortwin 2008. Risk Governance: Coping with Uncertainty in a Complex World. Earthscan: London.

5.4. IRGC. 2017. "Introduction to the IRGC Risk Governance Framework", revised version. Lausanne: EPFL International Risk Governance Center.

6. Nuclear Waste

6.1. Micheal R., Greenberg, Bernadette M. West, Karen W. Lowire, Henry J. Mayer. 2009. The Reporter's Handbook on Nuclear Materials, Energy and Waste Management. Nashville: Vanderbilt University Press.

TM7

Conflict Management

Understanding and managing conflicts about energy technologies

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Teachener

Funded by the Erasmus+ Programme of the European Union

Introduction

Public controversies and conflicts about innovative technologies are part of technology development. In many European countries and other places around the world, energy technologies—like other technologies—are often confronted with society's increasing sense unease in relation to science and technology development.

» *Conflicting interests, value systems and risk perceptions lead to controversies about energy technologies.*

Controversies often occur at the local and regional level when it comes to large-scale energy infrastructure such as nuclear power plants, geothermal facilities or high-voltage power grids. The most visible expressions of such controversies are protest camps or demonstrations. However, conflicts can take many other forms. They can last for decades (e.g. the conflict surrounding nuclear power in Germany) and they can have intense, widely visible phases and phases of low intensity that make the conflict invisible. Conflicts evolve and modify over time and may become institutionalized.

Conflicts about energy technologies that take the form of protest by are perceived by the proponents of energy technologies as annoying, as they endanger the realization of intended projects. In such situations,

» *engineers and scientists often have to deal with the controversies and are usually not familiar with the concepts and strategies required to understand and resolve the situation.*

Those who want to construct the energy infrastructure—industry, scientific experts, politicians—often view protesters as irrational (even stupid), reluctant, technophobic and selfish. Such conflict situations are commonly referred to as the NIMBY phenomenon: Not In My BackYard (Devine-Wright 2011). The approach that seemingly provides a solution is to generate public acceptance for the new technologies. However, this understanding and both concepts—NIMBY as well as public acceptance—fall short.

» *A social science perspective makes it possible to understand the local interests and values that underlie protest and criticism.*

Local interests are societal interests comparable to the interest in producing and providing energy. Furthermore, a social science perspective highlights the role of power struggles and enables people to consider the position of the experts and industries. Such actors do have interests, but their interests are presumed to be societal interests: providing energy, conducting research, etc.

Social sciences aim to understand the causes of conflicts, their dynamics and, based on that, suggest how to deal with conflicts. Conflicts related to energy technologies have always been a topic of social science research.

» *Over the last decades, the issue of renewable energy and related conflicts found its way into the social sciences in many countries around the world.*

Research mostly focuses on conflicts related to siting energy technologies such as wind turbines or geothermal power plants (cf. Devine-Wright 2011; Kousis 1993; Pellizzone et al. 2017).

Social science analyses of conflict focus on the dimensions that come into play, such as power struggles, struggles surrounding knowledge, and the role of science and expertise in socially relevant issues like energy provision. Another field of social science research is conflict management. Social sciences ranging from sociology and geography to law and economics are all contributing to the development of approaches such as mediation and compensation.

The teaching module is composed of 3 successive sessions:

1

Session 1: Why and how do we talk about technological controversies?
A general introduction to a social science perspective on technological controversies.

60 minutes

2

Session 2: Role play panel discussion about a geothermal energy facility
Students will be taught the necessary techniques for revealing and understanding the different interests, objectives, and values of (groups of) actors that come into play in technological controversies.

90 minutes

3

Session 3: Key questions for understanding conflicts and an introduction to conflict management approaches
is devoted to developing central questions that should be posed in order to analyze and understand a technological controversy. It ends with a short introduction to conflict management approaches.

90 minutes

Session 1:

Why and how do we talk about technological controversies?

a) Session objectives

This session provides a general introduction to social science perspectives on technological controversies. It also aims to equip students with basic knowledge about how conflicts are defined and conceptualized in the social sciences.

b) Session scope

The notion of conflict refers to a situation in which two or more actors disagree on something, such as the division of resources, what decision to take in a given situation (rules of decision making), the importance of different values in decision making, or goals for future development (Crouch 2015).

» *UNLIKE OUR EVERYDAY PERCEPTION OF CONFLICTS, WHICH OFTEN FRAMES CONFLICTS AS SOMETHING NEGATIVE, A CONFLICTING SITUATION IS NOT NECESSARILY POSITIVE OR NEGATIVE.*

Instead, it is simply a situation of social struggle and, consequently, it is a specific social relationship that requires the interaction of the struggling parties. However, in social science there is no general theory or concept about what a conflict is. In social science, there are two basic perspectives and assumptions about conflicts: 1) conflicts as exceptional situations that reveal malfunctions in social systems and institutions and 2) conflicts as a normal and integral part of social relations that form the basis of social change and development (cf. Crouch 2015).

Techological controversy

A technological controversy is a disagreement between actors about aspects of technologies, such as their risks and potentials, their usefulness for society, the values linked to them, related knowledge, the power that might be exerted by using them, as well as technology-related decision making (Hennen 1999). NOTE: The terminology in social science is not consistent. You will find terms such as “technology controversies”, “technological controversy”, “controversy about technology”, “controversial technology”, or “controversial technology issues”. Although it is unusual to refer to a disagreement between actors about aspects of technologies as a “conflict”, a technological controversy is indeed a specific type of social conflict.
Technological controversies may occur throughout a technology’s entire life cycle: early stages of development, implementation, utilization, and end of use. These controversies usually gain public attention when divergent perspectives, interests, and values are articulated through various forms of protest (as illustrated by the introductory video sequence). This often happens when locations are being selected for new energy infrastructure that is visible and affects the shape of the landscape (e.g. wind turbines, power plants) (Devine-Wright 2011).

Consequently, conflicts about energy technologies usually occur at either the meso level or the macro level. In the context of local conflicts about energy infrastructure, even the micro level comes into play.

Understanding and analyzing conflicts

Source:
https://www.euractiv.com/section/climate-environment/news/german-anti-coal-demonstrations-were-running-out-of-time/

In order to understand and analyze conflicts, social scientists focus on various different aspects. Three of these aspects will be dealt with within this session: dynamics of conflicts, dimensions that underlie each conflict: interests, knowledge, values, effects of conflict: positive and negative aspects.

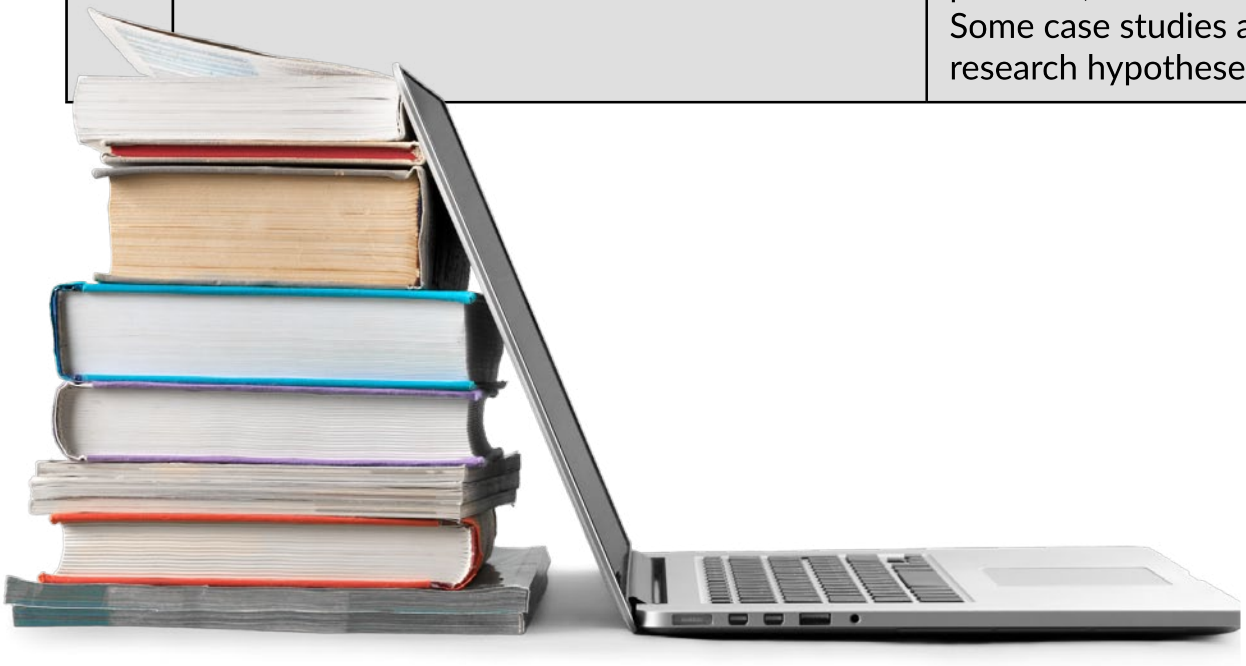
The term "the dynamic of conflict" is used to draw attention to the fact that a conflict may evolve and change over time. The analysis of the dimensions makes it possible to identify exactly what motivates the conflicting parties to enter into a dispute. Usually all three dimensions are present—to varying extents—within a conflict. The effects of technological controversies can be positive or negative depending on the position and perspective of the actors within the controversy. The effects also depend on how the controversies are dealt with and how they are solved.

» *A PROFESSIONAL APPROACH TO CONFLICT MANAGEMENT CAN TRANSFORM THE NEGATIVE DYNAMICS OF A CONFLICT INTO POSITIVE DYNAMICS AND ACHIEVEMENTS.*

Some approaches to conflict management will be discussed in the third session of this module.

c) Pre-reading

No.	Author and title	Description
1.	Crouch, Colin. 2015. Conflict Sociology. In: Wright, James (ed.) International Encyclopedia of Social and Behavioral Science. Elsevier, pp. 2554–2559.	This article provides a very short overview about how conflicts are understood in social sciences. It is structured according to four variables: conflict as exceptional or endemic and as momentous or mundane.
2.	Hård, Mikael. Beyond Harmony and Consensus: A Social Conflict Approach to Technology. „Science, Technology & Human Values" 1993, Vol. 18, Issue 4. DOI: 10.1177/016224399301800402	This article presents a sociological perspective that suggests that technology should be seen as a means for groups to retain or rearrange social relations. It contains two main arguments. Firstly, it claims that the sociotechnical systems approach in technology and society studies often tends to portray harmony and cooperation as the ideal outcome. Secondly, while central social constructivists tend to interpret closure and stabilization processes in terms of consensus, this article argues that technology should instead be regarded as the outcome of conflicting interests and ideas. To make this perspective plausible, a number of analytical concepts are put forth and illustrated. Some case studies are reinterpreted in conflict language, and a few tentative research hypotheses are formulated.



d) Session activities

Activity 1: Video input

Methods	Video presentation
Keynotes	If the number of participants is 10 or less, a short round of introductions is recommended (e.g. name and field of study and research).
Materials	**TM7-S1-RM-01-video**
Required accessories	Computer + projector
Time allocation	10 min
Learning outcomes	Students will gain an idea about the forms that conflicts against energy infrastructure projects may take (e.g. protests).

This introductory task presents a short video sequence to give an idea about the forms that conflicts against energy infrastructure projects may take (e.g. protests). The teacher should briefly contextualize the video if this is not clear in the video itself (where, who, what issue, etc.).

It is important to stress that critiques of energy technologies can take many more forms than the protests shown in these videos. The videos simply illustrate a very visible expression of conflicts about energy technologies. However, this input can be used to start a discussion about the students' own experiences and perception of conflicts, and to guide their thinking towards the issues covered in the lecture that follows.

Activity 2:
Exploration task

Methods	Guided discussion
Keynotes	If possible, the teacher should write down a few important points (e.g. on small cards to be pinned on a pin board), so that these can be referred to later on. Alternatively, you could give the students time after the video to write down up to 3 impressions on idea cards – these than can be put on a pin board as well.
Materials	**None**
Required accessories	Possibly idea cards, pin board
Time allocation	10 min
Learning outcomes	Students will become aware of the causes of conflicts and the mechanisms and actors involved in conflicts. They also will acquire knowledge about the forms that conflicts about energy technology and energy infrastructure may take.

The idea of this task is for students to become aware pf the causes of conlficts and the mechanisms and actors involved. The students are asked to comment of the film they have watched in activity 1. Mechanisms and actors should be identified. The teacher should guide the students to reach conclusion what forms of conflicts may occur in the field if energy technology.The following questions can be posed to the students after showing one (or two) of these video inputs:

- *What did you see? What did the video show?*
- *What arguments are brought forward? By whom? Who is criticized?*
- *What was (not) surprising?*
- *What are the goals of the protestors? (e.g. symbolic action, raising awareness about the issue of sustainability in relation to energy technologies and energy sources) Which issues are raised? (e.g. responsibility of public research institutions, public health issues)*

Activity 3: Lecture

Methods	Lecture using PowerPoint slides
Keynotes	The terminology in social science is not consistent. You will find terms such as “technology controversies”, “technological controversy”, “controversy about technology”, “controversial technology”, or “controversial technology issues”. Although it is unusual to use the word “conflict” to refer to a disagreement between actors about aspects of technologies, a technological controversy is a specific type of social conflict.
Materials	**TM7-S1-RM-02-ppt_lecture_technological controversies_lecture_technological controversies**
Required accessories	Computer, projector
Time allocation	40 min
Learning outcomes	Students will gain basic knowledge about the definition, understanding and concepts of technology conflicts in social sciences.

The idea of this introductory lecture is for the students to gain basic knowledge about the definitions related to conflict. The concept of is introduced and commented. The teacher presents and discusses what is technological controversy and how to such controversies arise. Next, stress is put on the process of conflict evolve and development. Students are presented with dimensions (analytical) of conflict wich can be identified. Finally, implication and effects of technological controversies are presented and discussed.

e) Additional resources

No.	Author and title	Description
1.	TM7-S1-RM-00-ppt_Module overview	A general presentation of the whole module.

Session 2:
Role play panel discussion about a geothermal energy facility

a) Session objectives

This session is designed to be a working session focused on individual and group work and development. It is conceptualized as a type of role play, however it does not go into great personal detail regarding roles of the actors. The students take on the roles of different actors within a discussion about a technological controversy. This gives them the opportunity to reveal and understand the different interests, objectives and values of (groups of) actors that come into play during technological controversies.

b) Session scope

A role play will be carried out, based on a fictive conflict setting.

c) Pre-reading

No.	Author and title	Description
1.	Craciun, Dana. Role-playing as a creative method in science education. „Journal of Science and Arts” 2010, Vol. 10, Issue 1. http://www.icstm.ro/DOCS/josa/josa_2010_1/c.11_role_playing_as_a_creative_method_in_science_education.pdf	Both articles provide an overview about the role play method in higher education, its aims, characteristics, challenges, and effects.
2.	Skelton, John et al. 1999. Role play as a teaching methodology. Barmingham: University of Birmingham. https://ler.letras.up.pt/uploads/ficheiros/6089.pdf	

d) Session activities

Activity 1: Introduction

Methods	Lecture using PowerPoint slides
Keynotes	None
Materials	**TM7-S2-RM-01-method_of_roleplaying** **TM7-S2-RM-02-description_of_the_case** **TM7-S2-RM-03-ppt_illustration_of_the_case_description**
Required accessories	Computer, projector, hand-outs
Time allocation	10 min
Learning outcomes	The students learn about the role play teaching method as it is used in this module. They also gain an understanding about the controversy used for the role play.

The aim of this activity is for the students to familiarize themselves with role playing teaching methods. The teacher introduces the group work and briefly describes the methodology of the role play, the idea behind it and the aims of the activity (understanding divergent positions regarding a technological project; discovering how and why a conflict gains momentum (or not); understanding what a conflict feels like). Next, the scenario that forms the starting point and background for the role play is introduced. The students should be reminded about the details of the scenario by referring to the activity hand-out.

Activity 2:
Preparing the panel discussion

Methods	Group work
Keynotes	None
Materials	**TM7-S2-RM-04-Role_of_the_moderator** **TM7-S2-RM-05-Role_Cards** **TM7-S2-RM-06_Handout groupwork_preparation_role_play**
Required accessories	**Preparation of the room** While the students prepare their roles, the teacher prepares the room for the panel discussion: • Place chairs in a U-shape for the audience • Place two tables at the open end of the U-shape with four chairs for the representatives of the groups and one chair for the moderator • Put name cards on the tables that feature the names of the groups (local politicians, project developers, citizens, environmental administration) as well as the names of the representatives
Time allocation	30 min
Learning outcomes	Familiarization with the differing positions of the actors within the conflict. Students should also recognize some of the points highlighted in the first session of the module.

This activity familiarize the students with different positions of actors within a conflict. The students are asked to form four groups that represent four different actors: 1) local politicians (city council, mayor), 2) project developers, 3) citizens, 4) local/regional environmental protection agency. All four groups are important for the discussion. Scientists do not form an own group because each of the aforementioned groups can rely on scientific expertise and advice that support their position. Therefore, the information provided on the hypothetical case (see below) does not clearly state whether the scientists are for or against the geothermal energy facility. If there are not enough students to form one group per actor, then actors can be represented by individual students to ensure that no actors are left out. Each group discusses the perspective (interests, capacities, etc.) of the respective actor. The students should prepare a short opening statement that describes their group's point of view. These statements are read out at the start of the panel discussion.

Once the role cards are distributed, any remaining questions about the role play should be clarified by the teacher. The cards intentionally contain some ambiguities regarding the roles of the actors – this gives the students greater freedom to interpret the roles for themselves and choose which aspects to focus on. Students who prepare this role can decide which position they will take within the role play. If students feel uncertain, you should help them to prepare for their role.

Activity 3:
Panel discussion

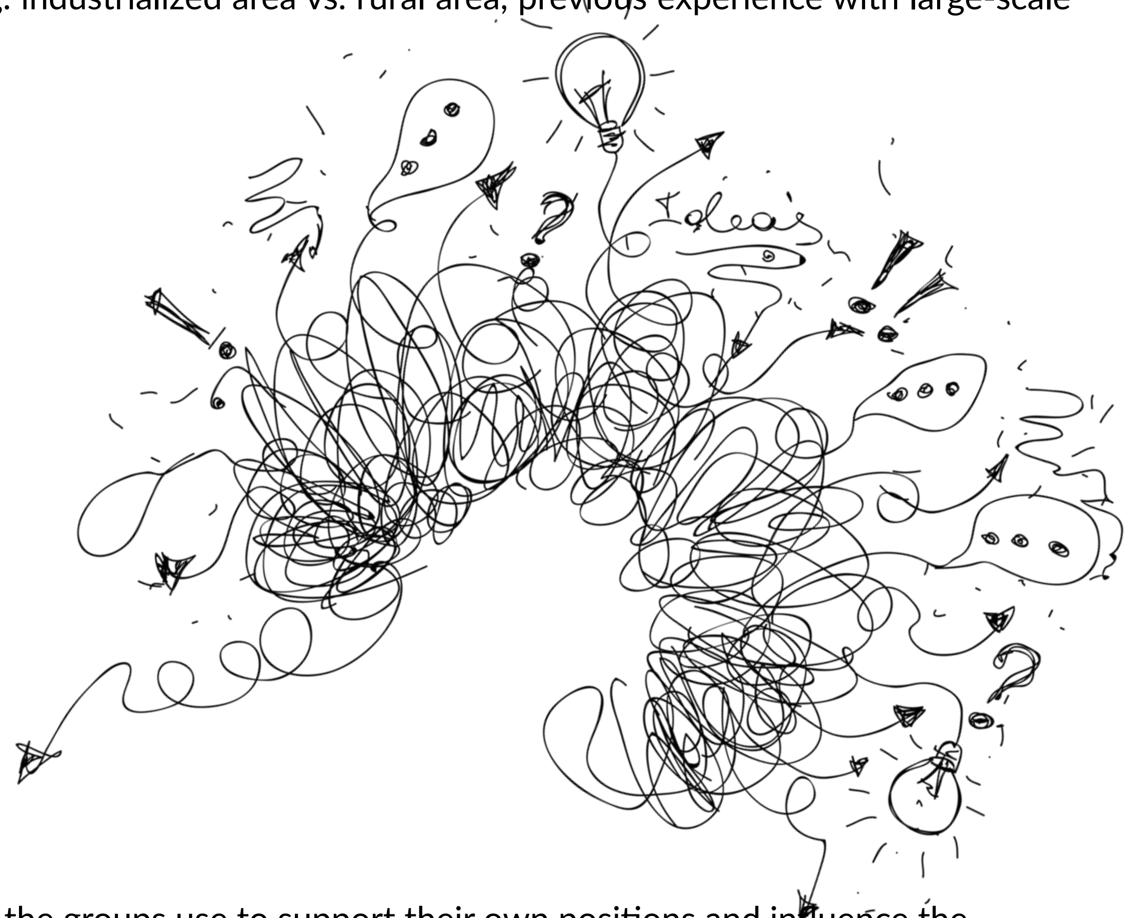
Methods	Role play in the form of a panel discussion
Keynotes	A fully-fledged role play aims to bring the students' emotions to the fore. After the role play, students should be encouraged to reflect on their emotions. This can be quite demanding. If you do not feel comfortable carrying out this task, you should guide the role play in such a way that it doesn't become overly emotional.
Materials	**None**
Required accessories	None
Time allocation	35 min
Learning outcomes	Understanding actors' different interests, objectives, and values within technological controversies. Students are given the opportunity to empathize with positions that are not familiar to them and develop awareness for diverging perspectives.

With this activity, the students gain basic understanding of actors different interests, objectives and values within technological controversies. The roleplaying game is started by the moderator who introduces the scenario and the panelists, and ask the panelists to present their position within the conflict. Each group explains their perspective on the issue at hand, their interests, goals, and expectations regarding what decisions should be taken. They also explain how they plan to articulate their interests, goals etc. (e.g. striving for a public debate, organizing protests, bringing in additional expertise, etc.). The moderator ends the discussion after about 20 minutes and summarizes the debate.

Activity 4: Reflection

Methods	Joint discussion
Keynotes	If possible, write down the arguments brought forward by the students during the reflection. Guide the discussion by summarizing and clustering arguments that the students make and by referring to conflict-related issues and categories that were introduced and/or discussed in the first session.
Materials	**None**
Required accessories	Idea cards, pin board
Time allocation	15 min
Learning outcomes	The students learn to reflect on the diversity of arguments and perspectives in the context of a socio-technical conflict, as well as the means used by actors to promote their arguments. Students should try to understand the reasons behind this diversity.

The aim of this activity is for the students to reflect on the diversities of the conflict students should be able to identify some points from the first session, such as differences regarding interests, values, and knowledge. The discussion may have revealed differing approaches regarding the rules of decision making (e.g. who should decide where the geothermal energy facility should be located?) and problems regarding trust (e.g. loss of trust as a result of the local council's press release). Depending on how creative the students were in preparing and presenting their roles, it might also be possible to discuss the question of conflict intensity and the means actors choose to support their own positions, as well as the role played by local history (e.g. industrialized area vs. rural area, previous experience with large-scale energy technologies).



The following questions can be used to start the reflection:

- Was it difficult to prepare the role? Why/why not?
- What happened during the discussion?
- What was the discussion about?
- Which arguments were raised and by whom?
- What are the interests of each group?
- What seems to lie behind the interests of each group?
- How did the groups of actors interact with each other?
- If applicable: Which methods or means (e.g. aggression) did the groups use to support their own positions and influence the debate? How did the other groups perceive and evaluate these methods?

Session 3:
Key questions for understanding conflicts and an introduction to conflict management approaches

a) Session objectives

In the third session, students are encouraged to develop central questions that can and should be posed when trying to analyze and understand technological controversies. This knowledge will be applied directly during a short group exercise about another technology conflict case. The session ends with a brief introduction to conflict management approaches.

b) Session scope

Dealing with a conflict – Approaches for conflict management

Generally, conflict management aims to deal with conflicts in a way that minimizes any effects that might hinder decision making. Regardless of which methods are used in a specific case, the main aim is always to initiate and facilitate communication between the conflicting parties, ensure communication takes place on equal terms, and create mutual understanding about the various positions.
In order to develop a strategy for managing a conflict, it is important to fully understand the conflict. During this session key questions are derived that allows understanding conflicts. Once the conflict is properly understood, it is possible to develop an appropriate strategy for dealing with it. Strategies and approaches are always case specific. Some examples of conflict management approaches are provided within this session, however please note this is not a comprehensive overview of all the possible approaches and strategies.
In the first session of this module, three types of conflicts were introduced: interest, value, and knowledge conflicts. This particular typology was selected as it is closely related to the question of how to manage conflicts (Ziekow et al. 2014). Arguments about interests and the (unfair) distribution of resources require a different approach to arguments that refer to basic values or arguments that refer to knowledge claims.

» *Identifying conflict types and applying appropriate methods to deal with them may seem simple. However, the task is not that easy as conflicts are always multidimensional and feature aspects of all three types of conflict (knowledge, interest and value).*

Furthermore, the relative importance of the different types may change over time. This also has to be considered when developing a strategy for dealing with conflict.

Success of conflict management

» *Success of conflict management always depends on the perspective of the conflicting parties and the participants involved in the conflict management process.*

Therefore it is important to distinguish between the success of the management approach, i.e. the process itself, and the success of the result/resolution produced by the conflict management. A useful indicator for the success of the process is the number of participants who are satisfied with the process despite being dissatisfied with the result/solution/outcome. The compliance of those who oppose in relation to the outcome indicates the quality of the process.

c) Pre-reading

No.	Author and title	Description
1.	Clarke, Tracylee, Tarla Rai Peterson. 2016. Environmental Conflict Management. SAGE Publications. DOI: 10.4135/9781483399522	This book is an introduction to the research and practice of environmental conflict management. Its content can easily be adopted for the content of this module. In particular, it is highly recommended that students read chapters 1 and 4 before commencing the module. The book provides a step-by-step process for engaging stakeholders and other interested parties in the management of environmental disputes. In each chapter the authors first introduce a specific concept or step of the process, and then provide exercises, worksheets, role plays, and brief case studies that enable students to directly apply what they have learned. The appendix includes six additional case studies for further analysis. These practical steps for understanding and managing conflicts are designed to help students make more informed decisions. The book also helps students to develop techniques for public involvement and community outreach, and includes strategies for effectively managing meetings, negotiating methodologies for communicating concerns and working through differences, as well as outlines for implementing and evaluating strategies for maintaining positive community relations.

d) Class activities

Activity 1:
Reflection

Methods	Repetition
Keynotes	It is important to bear in mind that none of the students' reflections are "wrong"—everything they say should be treated as an interesting point of view.
Materials	**None**
Required accessories	None
Time allocation	10 min
Learning outcomes	Reflecting on the experience of the role play activity.

The idea of this task is for the students to reflect and comment on the role play activity from the previous session. The teacher should use the notes taken in the previous session to compare the students' viewpoints and reflect them back to them. A chart with categories should be created that helps the students to understand the content.

- Different groups have different interests, values and knowledge
- Divergent perceptions of the rules of decision making
- Power relations between the actors; who is able to do certain things or act in certain ways? Why? (What resources are necessary for the ability to act?)

- The particular history of certain conflicts
- Development of the conflict and its intensity
- Means chosen to support one's own position

Activity 2:
Deriving key questions about a conflict

Methods	Discussion
Keynotes	It is important to allow the students to express their views with proper attention to previous session reference.
Materials	**TM7-S2-RM-03-ppt_illustration_of_the_case_description** **TM7-S3-RM-01-Key questions conflict**
Required accessories	Idea cards, pin board
Time allocation	25 min
Learning outcomes	Having developed questions that need to be asked in order to understand a technological controversy.

Based on the discussion about the role play, the students are asked to work out which key questions are necessary for understanding conflicts. The teacher guides a brainstorming session, which is based on this two-part question: What should you take into consideration if you want to understand a technological controversy and which questions would you ask? The students' answers should be noted on a idea cards and put on the pin board. The teacher should ask key questions on conflict to stimulate the discussion.

Activity 3:
Applying key questions to another case

Methods	(Reading), analyzing, discussion
Keynotes	**There are two options for carrying out this activity:** 1. Use the following newspaper article, published in The Guardian in: TM7-S3-RM-02-Vaughan_2017_newspaper_article_fracking_Wales. The article is about a hydraulic fracturing conflict in Wales (UK). This conflict was featured in one of the video inputs from session 1: "Protest against research on fracking carried out at a University in UK" (see TM7-S1-RM-01-video). 2. Ask the students if one of them has an example of technological conflict from their own personal experience or from the media. The student who has a suitable example shall briefly explain the example to the group.
Materials	**TM7-S3-RM-02-Vaughan_2017_newspaper_article_fracking_Wales**
Required accessories	None
Time allocation	20 min
Learning outcomes	Learning to transfer of previously acquired knowledge to a new case and thereby internalizing it.

During a discussion guided by the teacher, students are asked to answer the key questions that were developed during the previous activity:

- Actors and interactions
- Issues and history
- Handling the conflict

The students should be asked to apply the key questions in order to understand the conflict (either the conflict described in the newspaper article, or the one suggested by a student). In most cases not all the answers will be available, so students should at least realize that there is information missing. The teacher could ask the students where they think they could find the missing answers.

This task can be done with all the students, or split into smaller groups. If the teacher decides to split students up, then at the end a global summary of the whole discussion should be done.

Activity 4:
Lecture

Methods	Lecture using PowerPoint slides
Keynotes	None
Materials	**TM7-S3-RM-03-ppt_lecture_conflict management**
Required accessories	Computer, projector
Time allocation	15 min
Learning outcomes	Gaining basic knowledge about conflict management.

This activity is the main lecture of the whole module. It is designed to introduce to the students the basic knowledge about conflict management. The teacher introduces the identification of conflict arise in a project. Next, goals of conflict management are introduced which allow to define what conflict management is. Based on the definition, approaches to conflict management are introduced. The teacher defines what are the basic principles, factors and what are the requirements of a successful conflict management process. Finally, examples of conflict management are presented.

Activity 5: Intervention

Methods	Discussion
Keynotes	It is important to guide the students and correct mistakes in understanding immediately as they appear.
Materials	**None**
Required accessories	None
Time allocation	10 min
Learning outcomes	Application of knowledge from the lecture (activity 4).

This activity is designed to allow the students to practice the knowledge they have gained. The students are asked which approach they would use to deal with the conflict discussed in activity 3. Answers might include: involving conflict management experts, trying to gain a better understanding of the situation, considering the position and interests of the investor, identifying concrete methods for bringing the conflicting parties together. The students should demonstrate that they have understood the content of the previous lecture.

Activity 6:
Summary and conclusion

Methods	Repetition
Keynotes	None
Materials	**TM7-S3-RM-04-ppt_last slide**
Required accessories	Computer, projector
Time allocation	10 min
Learning outcomes	Revision of all the content in the conflict management module.

This activity is the summary activity of the whole module. The teacher should repeat the main points and ideas and stress the most crucial aspects of conflict management. The students should be interviewed at random to confirm their understanding of the basic required concepts and principles of conflict management.

Assessment methods and final assignment

In order to assess the achievements of the students, each student has to write a reflection on the role play of 2-3 pages. Within the reflection the student shall chose an issue/observation from the role play that kept he or she occupied, reflect on it and relate to one of the topics introduced in the course.

The reflection shall contain:

1. Short description of the observation.
2. Reflection on the own feelings.
3. Relation of the observation to one of the course topics (e.g. type of conflict, conflict management approaches etc.) by formulating hypothesis how the observation made intervene with the topic chosen.

The reflection is the basis to evaluate and grade the students achievements. Evaluate: overall structure, language, originality of the ideas, and correctness of facts.

Glossary

Actor	Within the context of the module an actor can be a single person or an institution e.g. local politicians (city council, mayor), project developers, citizens, local/regional environmental protection agency. The central point here is that an actor has a perspective on a technology controversy with its own interests, capacities to act, objectives and values, and that there are power relations existing between the actors.
Conflict(s)	The concept of a conflict refers to a situation in which two or more actors disagree about something or have different perspectives on a topic. A conflicting moment is not necessarily positive or negative.
Conflicts – dimensions of	In order to understand conflicts, social scientists identify three underlying dimensions that are independent from the issue driving the conflict. The dimension of interest addresses the mainly material advantages or disadvantages actors expect to result from energy infrastructures. In technology conflicts, the dimension of knowledge comes into play when the validity of the knowledge underlying arguments for energy projects is questioned. The final dimension addresses the values underlying actions and decision making.
Conflicts – dynamics of	This term is used to draw attention to the fact that a conflict may evolve and change over time, for example, in terms of the level at which it occurs, the spatial context, the actors involved or even its subject matter.
Conflicts – levels of	Conflicts have different social ranges, which is why they can be assigned to three types of levels for better understanding. When a conflict takes place between individuals, it plays on the micro level. Conflicts at the meso level concern relations between organizations, groups and institutions, such as environmental NGOs that criticize decisions and activities related to local policies or commercial enterprises involved in energy technologies. Conflicts at the macro level are played out within the political discourse. However, the same conflict can appear on different levels.
Conflict management	Generally, conflict management aims to deal with conflicts in a way that minimizes any effects that might hinder decision making. Regardless of which methods are used in a specific case, the main aim is always to initiate and facilitate communication between the conflicting parties, ensure communication takes place on equal terms, and create mutual understanding about the various positions.

Conflict management – success of	Success of conflict management always depends on the perspective of the conflicting parties and the participants involved in the conflict management process. Therefore it is important to distinguish between the success of the management approach, i.e. the process itself, and the success of the result/resolution produced by the conflict management. A useful indicator for the success of the process is the number of participants who are satisfied with the process despite being dissatisfied with the result/solution/outcome. The compliance of those who oppose in relation to the outcome indicates the quality of the process.
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.
NIMBY phenomenon (Not In My Back Yard)	NIMBY is a characterization of opposition by residents to a proposed development in their local area. It often carries the connotation that such residents are only opposing the development because it is close to them, and that they would tolerate or support it if it were built farther away.
Technological controversy	A technological controversy is a disagreement between actors about different aspects of technologies. After Leonard Hennen such aspects could be their risks and potentials, their usefulness for society, the values linked to them, related knowledge, the power that might be exerted by using them, as well as technology-related decision making. It is important to know that the terminology in social science is not consistent which leads to different terms used e.g. “technology controversies” or “controversial technology issues”.

Attachment: Syllabus

1 Name of the teaching module

Conflict Management – Understanding and managing conflicts about energy technologies.

2. Brief description of the subject matter

Public controversies and conflicts about innovative technologies are part of technology development. Like other technologies, energy technologies in many European countries are frequently confronted with society's increasing unease about science and technology development. Controversies about innovation often occur at the local and regional level when technologies that are developed in the context of their application, e.g. when it comes to selecting locations for large-scale energy infrastructure such as nuclear power plants, geothermal facilities or high-voltage power grids. In such situations, engineers and scientists are often not familiar with the concepts and strategies that can be used to understand and deal with the controversy.

The Conflict Management module introduces social science perspectives on conflicts. The module does not provide comprehensive conflict management training. Instead it delivers insights into how to understand technological controversies. Students learn that there are a variety of definitions, theoretical approaches and models available that can help them understand conflicts about technologies. The module introduces key questions about the functions, impact, dynamics, and potential outcomes of conflicts. Examples from the field of energy technology (e.g. nuclear energy and geothermal energy) are provided to illustrate the social science approaches.

In addition to knowledge about concepts and processes, a role play is used to provide students with an emotional understanding of conflict situations related to energy technology issues.

3. Complete SSH problems description

- Technological controversies about energy technologies and infrastructure occur frequently and are caused by conflicting interests, value systems, or risk perceptions.
- A basic understanding of how technological controversies develop, their dynamics and their (social) implications is useful for people involved in the selection of locations for technology projects.
- An awareness of the different perspectives and perceptions that come into play is important for understanding the development

of conflicts in general and controversies about technologies.

- Awareness forms the basis for an open-minded understanding that complex technological controversies are characterized by different perspectives, interests and values.

4. Prerequisites and contextual knowledge

There are no prerequisites, although students are expected to be interested in this topic. The module is mainly aimed at Masters and PhD students, but Bachelor students are also able to attend.

5. Learning outcomes

A) KNOWLEDGE

The students will learn about the extent to which a social science perspective is useful for understanding conflicts related to energy infrastructure and technologies. They will acquire basic knowledge about social science perspectives on technological controversies and learn which questions and dimensions are relevant in social science conflict analysis. This enables the students to gain a broader understanding of the key aspects of technological conflicts, to identify emerging conflicts and to undertake measures to deal with them (prevent or resolve).

B) SKILLS

Students will develop an awareness for the positions and interests of different actors in complex technological controversies related to energy issues. As a result, they will learn how to take an open-minded approach towards these different perspectives, interests and values.

C) SOCIAL COMPETENCIES

The students gain social competencies such as the ability to collaborate effectively, develop and defend the point of view of a peer group, put forward arguments within a debate, and acknowledge positions that differ from one’s own point of view.

6. Module structure

The module will consist of three sessions (see point 8) that are 1-1.5 hours each. These sessions can be taught consecutively in one day

or over a period of three days. If the module is taught in one day, there must be breaks between the sessions and a longer break between the second and third sessions.
A traditional lecture format will be used to introduce the issue of technological controversies and the conceptual ideas from SSH. Interactive elements will complement the traditional lecture format. The second session involves a role play that allows students to experience different points of view and emotions within a conflict situation related to energy technologies and infrastructure.
There are no homework tasks.

7. Teaching methods

- Lectures
- Interactive role play
- Discussions
- Group works

8. Class plans

Session 1. Why and how do we talk about technological controversies? (video input, group work, lecture supported by PowerPoint slides)

Time: 1 hour

- 10 minutes video input
- 10 minutes exploration task
- 40 minutes lecture

Description of the task

- Lesson to introduce the issue of technological controversies and related SSH perspectives:
    - *What is a technological controversy?*

- *How do technological controversies arise?*
- *What are reasons for the emergence of technological controversies (types of conflicts)?*
- *What are the implications of technological controversies?*
- *Why should we deal with technological controversies in the context of energy issues?*

Materials required

- (Additional material for a general introduction of the module: TM7-S1-RM-00-ppt_Module overview)
- TM7-S1-RM-01-video
- TM7-S1-RM-02-ppt_lecture_technological controversies

Teacher-student and student-student interaction

- Group work
- Traditional lecture

Session 2. Role play panel discussion about a geothermal energy facility (lecture, group work, role play, discussion)

Time: 1.5 hours

- 10 minutes introduction
- 30 minutes preparation of the roles
- 35 minutes role play
- 15 minutes brief reflection and summary

Description of the task

- Students are asked to carry out a role playing game. The storyline of the game is a panel discussion that brings together parties who have different positions about a planned geothermal energy project. The students play the roles of local citizens, the mayor and representatives of the local council, and the project developer/investor. A detailed description about how to organize the game is available here: TM7-S2-RM-02-description_of_the_case

Materials required

- TM7-S2-RM-01-method_of_roleplaying
- TM7-S2-RM-02-description_of_the_case
- TM7-S2-RM-03-ppt_illustration_of_the_case_description
- TM7-S2-RM-04-Role_of_the_moderator
- TM7-S2-RM-05-Role_Cards
- TM7-S2-RM-06-Handout group work_preparation_role_play

Teacher-student and student-student interaction

- The teacher prepares the game and guides the students
- The students prepare their roles and play the role play game

Session 3. Key questions for understanding conflicts and an introduction to conflict management approaches: group work and exercise combined with a lecture

Time: 1.5 hours

- 10 minutes content-related reflection about the role play (joint discussion between the students and the teacher)
- 25 minutes deriving key questions about a conflict (students guided by the teacher)
- 20 minutes applying the key questions to another case study
- 15 minutes lecture (introduction to conflict management approaches)
- 10 minutes intervention and discussion about conflict management approaches
- 10 minutes summary (of the whole module)

Description of the task

- The role play is used as a point of departure to systematize and deepen some of the aspects concerning technological controversies. After that an introduction into conflict management approaches will be given in the form of a lecture. Another case study is introduced with the help of a newspaper article or with the help of a student and the students then apply their new knowledge to this new case study.

Materials required

- TM7-S2-RM-03-ppt_illustration_of_the_case_description
- TM7-S3-RM-01-Key questions conflict
- TM7-S3-RM-02-Vaughan_2017_newspaper_article_fracking_Wales
- TM7-S3-RM-03-ppt_lecture_conflict management
- TM7-S3-RM-04-ppt_last slide

Teacher-student and student-student interaction

- Group work
- Student-student and student-teacher discussions
- Traditional lecture format

9. Literature

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Further reading:

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TM8

Decentralized energy systems

Social aspects of energy production and use

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Introduction

We are facing today a significant shift from classical, central and hierarchical systems of energy production and distribution, based primarily on big size power plants powered by conventional energy sources towards local, decentralised energy systems (DES) based mainly on renewable energy sources and smart grids solutions. Decentralising the energy system is about generating energy close to where it is going to be used.

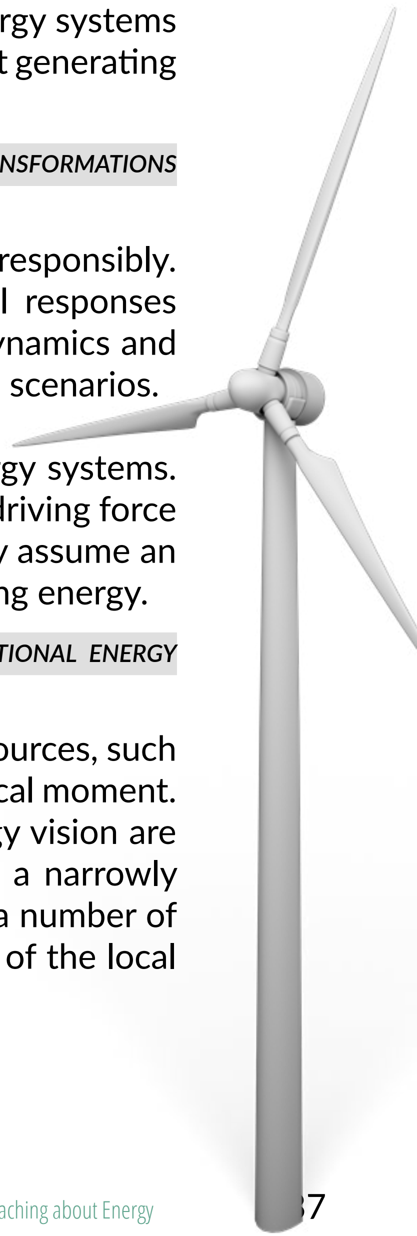
» *The change implies not only the implementation of new energy technologies, but also important social, cultural and political transformations in our societies.*

This shift allows a large number of consumers to become producers and to manage their energy consumption more responsibly. This requires a comprehensive assessment of their sociotechnical co-evolution, how technologies and societal responses evolve together, and how their co-evolution affects current trends. The goal of the course is to analyse drivers, dynamics and consequences of those complex socio-cultural trends. Focus will be put on the strategic analysis of possible futures scenarios.

The main aim of the course is to introduce students to the socio-political aspects of the decentralization of energy systems. The motivation behind these changes is not only due to technological developments or economic issues. The main driving force are wider social and political trends. Many energy supply projects that are being developed and implemented today assume an active role for consumers in energy production, who become ‘prosumers’, at the same time producing and consuming energy.

» *The shift towards being involved in energy production and deciding for oneself whether it is based on renewable or traditional energy sources is due to the* **growing public awareness of human-induced climate change.**

Therefore, not without significance is the fact that energy generated by households is based on renewable energy sources, such as windmills or photovoltaic cells. The aim of the classes is to make the students aware that we are currently in a critical moment. In the face of anthropogenic climate change, the discussion and decisions related to future scenarios of the energy vision are absolutely crucial. In order to understand the significance of these changes, it is necessary to move away from a narrowly understood technical and economic analysis. The changes towards decentralised energy systems are entangled in a number of social issues. Energy decentralisation is a part of a political decentralisation, with the emphasis on the importance of the local communities and their responsibility for itself.



The teaching module is composed of 3 successive sessions:

1

Session 1: Innovative Technological Solutions in Energy Production and Distribution
consists of a lecture and group work, the subject of which are the selected technical and economic aspects of decentralisation of energy systems.

115 minutes

2

Session 2: Decentralized Energy Systems from SSH perspective
is similar in form but concerns socio-political aspects.

135 minutes

3

Session 3: Scenario analysis: 'Road map' and 'What if?
takes the form of a scenario analysis exercise and summarizes the course.

135 minutes

Session 1:

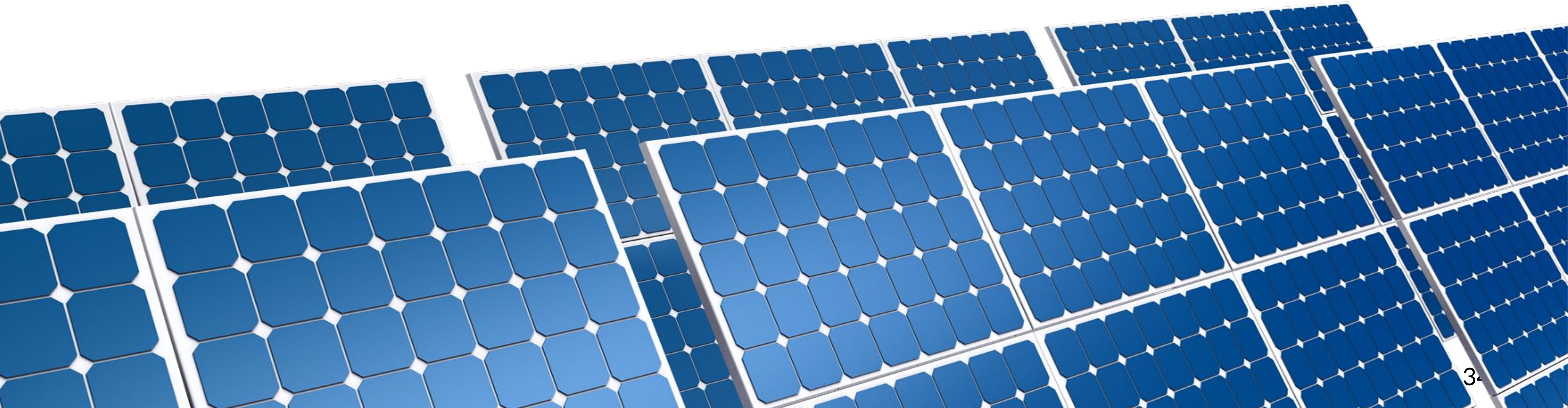
Innovative Technological Solutions in Energy Production and Distribution

a) Session objectives

This session is intended to give students an inside general knowledge of DES technical and economic drivers. After this session, students should have an understanding of main technological options of DES, the shape of future electricity systems and the role of energy customers in DES. Students will gain skills in calculating and evaluating Levelized Cost of Energy (LCOE) and achieve understanding of the factors that influence the adaptation of DES.

b) Session scope

The technical, organizational and legal structures of traditional electricity system have been designed around a limited number of large-scale centralized generation plants connected to a grid that carried (one-way) electricity to customers. With decentralized energy systems that are expected to employ many small-scale distributed units of energy generation, storage, and demand services, electricity grids will notice power flowing in both directions, with more customers producing their own energy and more customers actively shaping their own load profiles. Not only will it reduce energy demand from the central generation, but it will also require revised management of the flow of electricity in real time, use of advanced communication technology, along with proper schemes for assessing costs of distributed generation services.



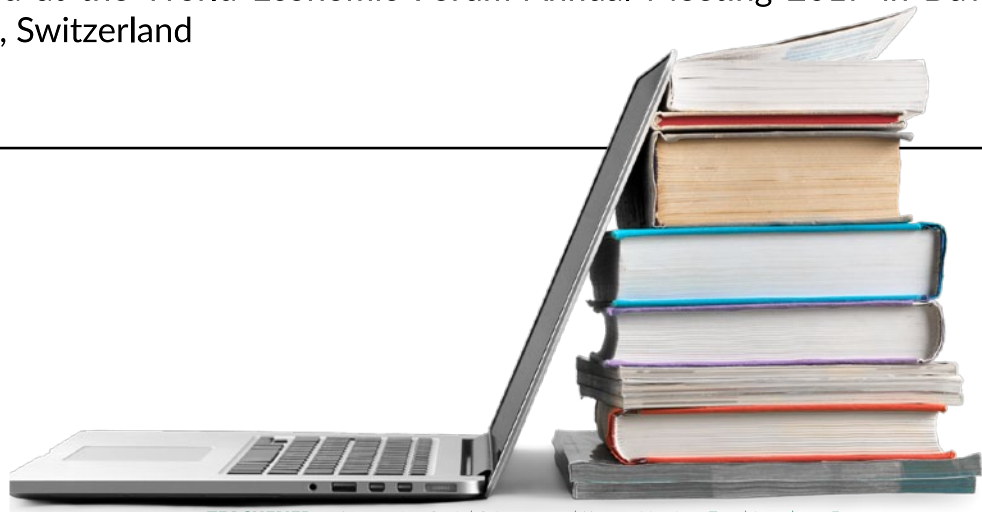
Distributed generation can benefit customers and the system in several valuable ways. For customers, solar can be an attractive and economical option, especially in sunny areas where it generates more electricity. Deployment of solar PV panels has increased dramatically in recent years with global installed capacity reaching 260 GWp (gigawatt-peak) in 2015 and expected to surpass 700 GWp by 2020. This growth has brought down the installed price of residential solar PV from about $7 per watt in 2009 to $3 per watt in 2015 in the US (and less than $3 in parts of Europe, such as Germany). For the system overall and for utilities, distributed generation can supply electricity directly to some percentage of customers, and depending on the status of the grid infrastructure, allows deferral of capital investments to maintain and upgrade grids and related services when these are less economical. In some cases, distributed generation may be the most affordable and expedient way to support load growth, particularly where it would be too expensive or time consuming or difficult to add new infrastructure – see pre-reading materials (WEF 2017).

Incentive programmes to encourage distributed generation in the form of rooftop solar photovoltaic technologies have been extremely effective in many cases, and customers have embraced them in many countries. New technologies, such as rooftop solar tiles and building integrated PV (BIPV), are now becoming available, broadening the future potential of distributed generation (WEF 2017).
Energy storage adds flexibility to the system, allowing those electrons to be stored and discharged later when they are needed – for example in evening hours or during times of peak demand. Thus, storage offers a way to flatten out the peaks and valleys of supply and prevent disruptive economics. Today, utility-scale storage (in front of the meter) accounts for the majority of installed storage capacity, providing numerous system functions, and is also proving an effective way to complement peaking plants. Storage is becoming cheaper as a result of advances in battery technologies and is achieving higher capacities that will allow for larger scale deployment. Projections estimate that demand for energy storage, excluding pumped hydro, will increase from 400 MWh globally in 2015 to nearly 50 GWh in 2025. Lithium ion batteries will make up most of the market, and those are likely to become more economical as vast quantities are developed and deployed for use in electric vehicles, a market where the demand for these batteries could reach 293 GWh by 2025 (WEF 2017).

This session introduces and explains main technical and organizational factors that drive the change from centralized to decentralized energy systems (DES). Initial presentation discusses emerging DES options and factors that make the change necessary and feasible. A list of technical and economic pros and cons of DES is given and discussed with students. Then, more stress is put on the economic drivers demonstrating the present competition between centralized and decentralized technologies. Students calculate the Levelized Cost of Energy (LCOE) of several DES technologies and compare it with actual prices of electricity (produced mainly in centralized energy systems). Finally, discussion on the analysis results and parameters will make students aware of DES adoption perspectives.

c) Pre-reading

No.	Author and title	Description
1.	Wolfe, Philip. The implications of an increasingly decentralised energy system. „Energy Policy" 2008, Vol. 36, Issue 12. DOI: 10.1016/j.enpol.2008.09.021	The paper discusses the concept and available technologies of decentralized energy systems that means the production and distribution of energy within the boundaries of, or located nearby and directly connected to, a building, community or development.
2.	Bruckner, Thomas et al. 2014. Energy Systems. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA. https://www.ipcc.ch/site/assets/uploads/2018/02/ipcc_wg3_ar5_chapter7.pdf	The energy systems chapter addresses issues related to the mitigation of greenhouse gas emissions (GHG) from the energy supply sector. The energy supply sector, as defined in this report, comprises all energy extraction, conversion, storage, transmission, and distribution processes that deliver final energy to the end-use sectors (industry, transport, and building, as well as agriculture and forestry).
3.	World Economic Forum. 2017. The Future of Electricity. New Technologies Transforming the Grid Edge. http://www3.weforum.org/docs/WEF_Future_of_Electricity_2017.pdf	The report presents a view of the evolving electricity landscape, as it was discussed at the World Economic Forum Annual Meeting 2017 in Davos-Klosters, Switzerland



d) Session activities

Activity 1: Introductory lecture

Methods	Lecture
Keynotes	It is important to avoid any other comments besides technical ones.
Materials	**TTM8-ST1-RM1-Innovative Technological Solutions**
Required accessories	Computer + projector
Time allocation	30 min
Learning outcomes	Understanding of technical and economic foundations of DES

The idea of this lecture is to give the students a **general perspective and knowledge of what Decentralized Energy Systems (DES) are, what are** their key components and how do they turn out in comparison to classic centralized systems. General definitions are given and discussed. The concept of **energy system transition** is given and future modelling is presented. The student is presented with benefits of DES and different options of economic justification. DES options are given with a general explanation of the presented examples. The factor of Distributed Energy Resources (DER) is presented and examples of current and future implementations are given. The student is familiarized with future projections and forecasting based on technological and economic factors. **The growth of energy consumption** is accented with such technologies as electric vehicles and home appliances to stress energy efficiency. The growing importance of demand response is highlighted with a profound stress on technology development. **Digitalization** of the entire grid is discussed as being one of the most important aspects of progress and development in DES. Finally, the role of the energy customer is elucidated as being more and more influential on future decentralized energy system development.

Activity 2:
Case study analysis

Methods	Lecture, workshop
Keynotes	Use the instruction handout to help the students.
Materials	**TM8-ST1-RM2-Case study method of analysis** **TM8-ST1-RM3-Case study presentation with analysis** **TM8-ST1-RM4-Case analysis instruction handout**
Required accessories	computer + projector, calculators, computer laboratory (optional)
Time allocation	45 min
Learning outcomes	Evaluation of DES in practice

The main goal of this activity is the student familiarization with the evaluation process of DES selection. A short, introductory presentation is given to make the students aware of the cost calculation procedure and to familiarize them with procedure and method of calculations. The procedure for calculating the cost of electricity is described in detail with a profound stress on common assumptions. Next, the students are presented with the case studies that they will evaluate/calculate. The students are divided into two groups and are asked to calculate the given cases. After completion, the students are asked to present the results, compare the two groups calculation results and draw conclusions. As feedback, significant parameters are listed.

Activity 3:
Consequence discussion

Methods	Guided discussion
Keynotes	Inform students that the results obtained at the activity 2 are approximate (many other technical/economic effects may need to be taken into account, e.g. taxes). Help directing discussion on social/political outcomes of DES introduction.
Materials	**None**
Required accessories	None
Time allocation	30 min
Learning outcomes	Identification of SSH aspects of DES

Activity 3 is a guided summary discussion of activity 2 from which arguments are drawn. The aim is to make the students come to two important conclusions: 1) that energy price from DES units can be competitive with energy price from centralizes large power plants; 2) that energy price is strongly dependent on the size of the generation unit – therefore, deciding on the DES option would more beneficial if more people would be involved, which may lead to new organizational/legal forms of energy generation. This in turn points out to social/political effects that arise from energy generation in DES.

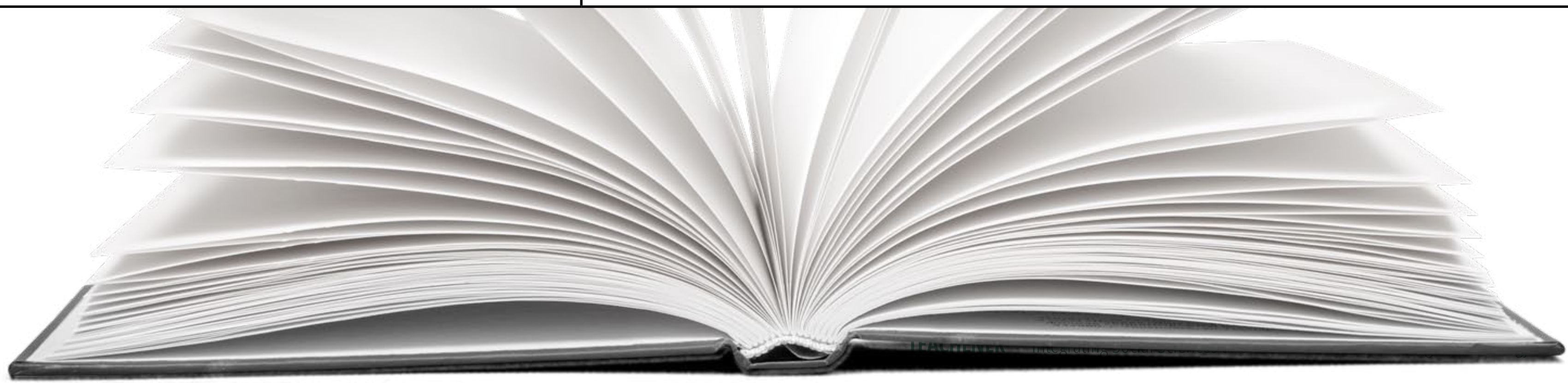
Activity 4:
Assignment for self-study

Methods	In-between session work, webquest
Keynotes	Ask the students to keep to the allotted time.
Materials	**None**
Required accessories	Presentation program
Time allocation	10 min
Learning outcomes	Identification and evaluation of a chosen DES case

The aim of this activity is for the students to investigate by themselves an existing DES example. It is a general facilitation exercise which is the ground for session 2. The students are asked to prepare a short presentation (up to 5 min) based on a selected DES case and technology.

e) Additional resources

No.	Author and title	Description
1.	Elfvengren, Kalle et al. The Future of Decentralized Energy Systems: Insights from a Delphi Study. „International Journal of Energy Technology and Policy" 2014, Vol. 10, Issue 3-4. DOI: 10.1504/IJETP.2014.066883	The paper evaluates how decentralized energy technologies will develop in Finland in the next five to ten years. By gathering data and insights, the paper also offers general views on future decentralized energy applications and market opportunities.
2.	National Academies of Sciences, Engineering, and Medicine. 2016. The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies. Washington, DC: The National Academies Press. DOI: 10.17226/21712	The report considers innovations that may improve the performance and lower the cost of currently available and help develop new advanced energy technologies.
3.	European Commission. 2012. Energy Roadmap 2050. Luxembourg: Publications Office of the European Union. DOI: 10.2833/10759	The UE brochure that comprises the text of the European Commission's communication 'Energy roadmap 2050' (COM(2011) 885 of 15 Dec 2011 The report debates how to put in place the policies, milestones and instruments to deliver European long-term goals: energy security, sustainability and competitiveness.



Session 2:
Decentralized Energy Systems from Social Sciences and Humanities (SSH) perspective

a) Session objectives

The aim of the session is for students to understand the socio-political aspects of decentralization of energy systems. The key dilemmas related to the decentralization are presented from the SSH perspective. Students are familiarized with different possible scenarios for decentralization of energy systems.

b) Session scope

From an economic and technological point of view, the change towards DES aims to reduce the costs of transmission and production of the energy itself. Although these factors are important, especially as global energy consumption is growing, they are not decisive. There are many social, cultural and political aspects which seem to play a key role in changing the way we think about energy. As it was presented in Session 1, most modern DES are based on renewable energy sources, e.g. biomass, biogas, geothermal power, small hydro, solar power or wind power. It is often the case that the current use of renewable energy sources is incompatible with ‚economic rationality'. The factor that determines that people want to use renewable energy sources is the growing awareness of human influence on the destabilization of the global climate. It is also related to the fact that people want to have more influence on energy management, which translates into social and political support for DES.

DES are not just technological speculation, futurology or distant plans - there are many initiatives and projects already in operation. Decentralisation of energy systems occurs in two socio-political settings: one is the climate change debate and the second the Global North and South divide. The former results in trends aimed at mitigating the human impact on the climate through reducing the CO2 emissions. This is also an important cultural trend promoting more eco-friendly styles of consumption. The latter setting deals with inequalities with energy access between developed countries of the Global North and less developed countries of the Global South. This debate is conducted mainly around the concept of energy poverty.
At the end of the session 1, students have been asked to investigate examples of DES. They present the results of the self-study assignments at the beginning of this session in form of short presentations, indicating the most important features of the DES projects. The teacher will then give the students a lecture with an overview of social aspects of DES: current socio-political trends contributing to decentralisation of energy systems, contexts of application, worries and hopes related to DES development. The presentation will be completed with a detailed presentation of an example of the German village of Feldheim.

c) Pre-reading

No.	Author and title	Description
1.	German Village Becomes Model for Renewable Energy Code: TM8-ST2-AM1	News containing information about Feldheim.
2.	Kang, Lin. Energy Self-Sufficient Ecovillage Code: TM8-ST2-AM2	Thesis, in which Chapter Four focuses on the example of Feldheim.
3.	Distributed Energy Systems. Flexible and Efficient Power for the New Energy Era Code: TM8-ST2-AM3	Scientific project on DES describing four cases.

d) Session activities

Activity 1:
Risk identification exercise

During this activity students present examples of DES projects they have self-studied. The follow-up discussion should be focused on SSH aspects. Attempts can be made to classify the projects in terms of, for example, autonomous bottom-up initiatives, government/EU initiatives, motivations of participants, sources of funding, the share of renewable energy sources, etc. The classification depends to a large extent on the DES examples presented by the students. The examples and their classifications are intended to show different alternative scenarios for the development of the DES. It may also be discussed which scenarios seem the most promising from various SSH perspectives.

Methods	Presentation
Keynotes	The teacher should focus exclusively on the political and social aspects of the DES. It should also draw attention to the fact that many technical aspects can be taken into account from the socio-political side, e.g. sharing local power plants, sharing the revenues from sold surplus energy, bottom-up financing of specific technological solutions, etc.
Materials	**None**
Required accessories	Computer+projector
Time allocation	30 min
Learning outcomes	Students will have opportunity to confront the examples they have found of contemporary attempts to decentralize energy systems, as well as how they perceive what SSH aspects are.

Activity 2:
Decentralized energy systems – social aspects

Methods	Presentation
Keynotes	The teacher should focus exclusively on the political and social aspects of the DES. It should also draw attention to the fact that many technical aspects can be taken into account from the socio-political side, e.g. sharing local power plants, sharing the revenues from sold surplus energy, bottom-up financing of specific technological solutions, etc.
Materials	**TM8-ST2-RM1-DES**
Required accessories	Computer+projector
Time allocation	55 min
Learning outcomes	Students will be acquainted with the most important examples of contemporary solutions for DES and the most important threads in the discussions about them.

This activity tends to present social, political and cultural aspects related to development of DES, focusing on the climate change debate and the Global South and North divide. Students are introduced with concepts, notions, trends and phenomena either influencing or resulting from development of DES.

In case of global climate change debate following issues play an important role:
- Policy trends such as transitions to low carbon emission technologies (‘Energy transitions’).
- Departure from conventional energy sources.
- Popularity of eco-friendly ways of life in Western European culture.
- Development of electro-mobility industry.
- Growing sector of renewable energy sources (RES), coupled with EU Energy Goals supporting the development of RES.
- Energy prosumption as a growing trend in the energy market.
- Green economy.

As an illustration how the climate change debate translates into energy trends may serve the **Energy Union Strategy** and the **2050 Energy Roadmap**. Decentralization of energy systems is one of the instruments to achieve the goals and decrease CO2 emission caused by conventional energy production systems.

An important role in DES plays the concept of ‘energy community’, i.e. a community which is independently meeting (partially or totally) its own energy requirements – i.e. heating, cooling, electricity or all three – through decentralized generation. Excess energy, where available, is sold back to the grid. The ‘energy community’ concept resulted from a social movement promoting the use of renewable energy sources (RES) on a local scale and in world economy as a part of a new, more eco-friendly way of life. It is also recognised by EU law.

There are numerous examples of local energy communities based on production and consumption of energy from ‘own’ energy sources (energy prosumption). They are often technologically innovative and make use of smart metering technology, as well as blockchain and artificial intelligence in energy contracting. Sometimes they take the form of fully autonomous and self-sufficient ‘ecovillages’. Examples of such initiatives can be found in Additional Resources section of this session. In the presentation, the case of Brooklyn Microgrid has been selected for the lesson.

Development of DES takes place within a broader paradigm called ‘**energy transition**’, which describes the reorientation in energy policy occurring due to global climate change and meaning shift towards decentralized renewable energy systems.

From a socio-cultural point of view, the trend towards decentralization and local production, distribution and consumption of energy can be seen as part of the '**energy democracy**' approach, which emphasizes the role of citizens in taking decisions on energy development strategies in their communities, governing the energy systems autonomously and participating as prosumers in local energy market.
The other perspective of DES development, Global North vs Global South, deals primarily with the problem of '**energy poverty**' in less developed countries. It refers to the situation of large numbers of people having very limited access to energy (mainly electricity), and thus very low consumption of energy, using dirty and polluting fuels to meet their needs and spending a lot of time collecting them.

According to the estimates of International Energy Agency, 1.2 billion people in the world do not have sufficient access to electricity. Most of them live in Sub-Saharan regions of Africa and India. However, the problem affects not only less developed countries, but also poor communities in Global North. According to IEA, energy demand in developing nations is likely to increase by 65% between 2010 and 2040. Decentralized energy systems (mini-grids) can be a solution for 70% of those living without energy access.

Example of Feldheim

Feldheim is a 100% energy self-sufficient "Ecovillage" in Brandenburg. Energy for households and local companies comes from windmills, photovoltaic cells and a biogas power plant (a product of methane fermentation of organic compounds e.g. sugar waste, municipal waste, animal waste, slurry, waste from the agri-food industry, biomass). The first wind turbines were built in Feldheim in 1995, and in small steps for almost twenty years, with strong financial support from the state, the inhabitants have gained green energy autonomy. However, it didn't come without troubles – the community had to negotiate the terms with the energy company, concerning the possibility to sell the surplus of produced energy to the central grid (see TM8-ST2-AM1).

The aim of the presentation is to present an example of DES-related phenomena, which are energy self-sufficient communities. Besides, the goal is to familiarize the students with real conditions in which the establishment of DES takes place.
The example enables to stress out possible scenarios for the impact of socio-political aspects on the implementation and development of specific technologies and solutions. It serves s a summary of the lecture and prepares students for the next activity.

Activity 3:
Socio-political scenarios of energy systems change – discussion

Methods	Presentation
Keynotes	The teacher should focus exclusively on the political and social aspects of the DESs. It should also draw attention to the fact that many technical aspects can be taken into account from the socio-political side, e.g. sharing local power plants, sharing the revenues from sold surplus energy, bottom-up financing of specific technological solutions, etc.
Materials	**None**
Required accessories	Computer+projector
Time allocation	40 min
Learning outcomes	Recognize that decentralization of energy systems has far-reaching socio-political consequences. As well as drawing attention to the fact that the trend towards decentralization is not only the result of technological possibilities, but also mainly of cultural factors.

Students should propose several possible scenarios for the development of decentralised energy systems (e.g. conversion of conventional power plants, focus on the idea of being a prosumer, importance of the role of renewable energy sources). Students should discuss future forecasts and evaluate them in a socio-political perspective. The discussion should end with a summary done by the teacher, who comments on the conclusions drawn by the students.

Activity 4:
Introduction to scenario analysis

Methods	Discussion
Keynotes	The teacher should focus exclusively on the political and social aspects of the DESs. It should also draw attention to the fact that many technical aspects can be taken into account from the socio-political side, e.g. sharing local power plants, sharing the revenues from sold surplus energy, bottom-up financing of specific technological solutions, etc.
Materials	**None**
Required accessories	None
Time allocation	10 min
Learning outcomes	Students are familiar with the principles of scenario analysis techniques. Readiness to prepare two kinds of scenario analysis regarding decentralised energy systems.

In this activity students are only presented with rules of the activity which will open the next session, to help them prepare for it. They are divided into two groups and asked to prepare themselves for doing a scenario analysis during the next session.

They should adopt roles of experts team members from a **consultancy company hired by the European Commission** in order to prepare a scenario analysis on the future of DES. One group as the experts team prepares a 'Road map' analysis, the second one a 'What if?' one.

In the ‘Road map’ exercise the expert team has been asked by the EC to present a plan to transform the European energy system from its current state to a 100% decentralised one in ten years from now. They should describe the way leading to introduction of decentralised energy system in Europe instead of existing centralized systems. They have to indicate processes and key factors which would enable a total resignation of centralised energy systems on EU-level in ten years. In order to do so, students should identify existing (and expected) barriers and opportunities, advantageous and (dis)advantageous conditions for DES development. They should identify chances and obstacles on economic, political, social, cultural and technological level. In other words, they have to show what should happen in the EU to enable the decision of abandoning centralised energy systems in Europe in ten years.

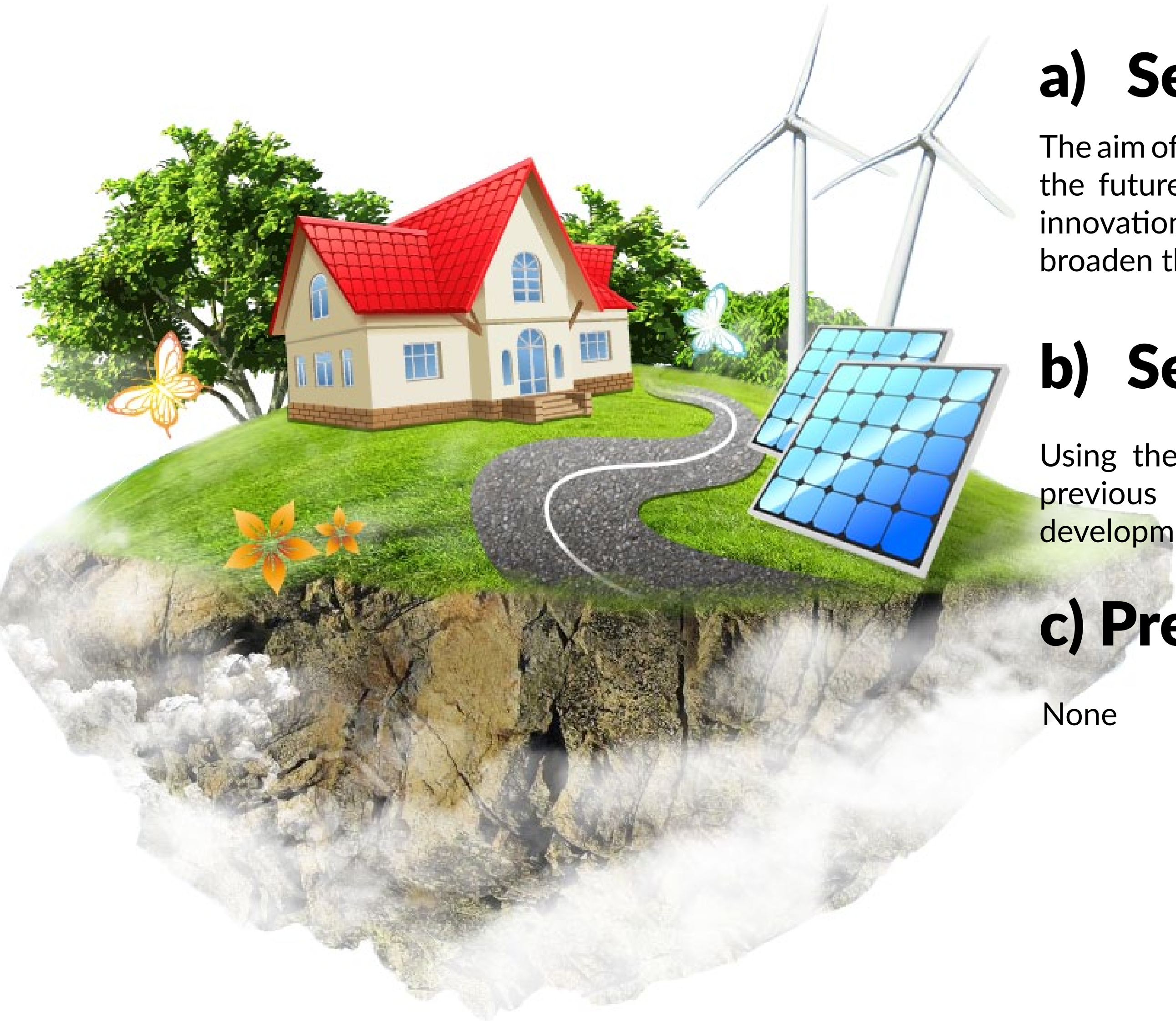
The ‘What if?’ analysis starts from the point where the ‘Road map’ ends. In this exercise the other expert team has been asked by EC to identify possible consequences of introduction DES in the EU and resignation of centralised systems. Students have to think about technical, economic, political and social consequences of DES development for the European countries.

At the end students are asked to divide the work within the teams between their members and get ready for preparations for the discussion between session 2 and session 3.

e) Additional resources

No.	Author and title	Description
1.	This Is What Energy Democracy Looks Like https://www.youtube.com/watch?v=A2c9vsJeGFM	Introductory video on energy democracy.
2.	The energy transition to energy democracy https://www.youtube.com/watch?v=ZTmeNmWEupg	Video showing how to move towards energy democracy.
3.	Renewable Energy Technologies in Denmark https://www.youtube.com/watch?v=d4eiTbPV47g	Video showing exemplary technological solutions of renewable energy in Denmark.
4.	Ten Years of Community Energy https://www.youtube.com/watch?v=5QtvyrQHJQE	Scottish experiences with energy communities.
5.	Local Energy Systems https://www.eon.se/en_US/samhaelle---utveckling/local-energy-systems.html	Swedish experience of developing energy self-sufficient village of Simris.

Session 3:
Scenario analysis:
‘Road map’ and ‘What if?



a) Session objectives

The aim of the session is to develop among students ability to analyze the future consequences of the implementation of technological innovations. Through the scenario analysis method, students are to broaden their „social imagination".

b) Session scope

Using the two analytical methods presented at the end of the previous session, students analyse possible scenarios of DES development and its consequences.

c) Pre-reading

None

d) Class activities

Activity 1:
‘Road map’ and ‘What if?’ analysis

Methods	Group work/workshop
Keynotes	The teacher should be prepared to possibly help and guide the students.
Materials	**TM8-ST3-RM1-Innovative Technological Solutions** **TM8-ST3-RM2-Case prognosis**
Required accessories	Flipchart, markers
Time allocation	100 min
Learning outcomes	Competence to understand factors influencing development of DES as well as its consequences.

A brief reminder of the main rules of the ‘Road map’ and ‘What if?’ methods is given at the beginning. Students, divided into expert teams, prepare the analysis using knowledge and materials collected before the session. For the group work 60 minutes should be reserved. After that, a presentation of group work and subsequent discussion after each presentation comes (2x20 minutes).

While the first expert team present the results of the ‘Road map’ analysis, the second group takes the role of **EU Commissioners.** It should be announced to the students at the beginning of the session and each students should choose a role of a specific EU commissioner from the list given by the teacher. The list encompasses the real posts in the EC, such as Commissioner of Agriculture, Budget/Finances, Climate

Action, Communication Networks, Competition/Jobs, Education, Consumers/Health, Employment/Social Aspects. After the presentation of the first expert team, each member of EC will have to ask a question from his or her area of expertise.

Similarly, when the second expert team present the results of 'What if?' analysis, the first group of students takes the role of **European Parliament Members.** They represent different countries. Students form groups of 2-4 for one country. After the presentation, each group asks questions to the experts team, focusing on consequences of the presented scenario for their country.

Activity 2:
Summary discussion

Methods	Discussion
Keynotes	The results of the previous analysis should be distinguished as one resulting from the other. The concept of many factors and barriers should be stressed.
Materials	**None**
Required accessories	None
Time allocation	35 min
Learning outcomes	Verification of future analysis methods understanding

The aim of this activity is to facilitate the knowledge gained in this module. Profound stress must be put on the idea that the outcomes of future prognosis are dependent on the factors taken into account in the analysis.

e) Additional resources

None

Assessment methods and final assignment

Session 3 includes the final assignment in which the students are asked to conduct the 'Roadmap' analysis and the 'What if?' analysis. Criteria to be taken into account:

- Proper identification of barriers (cause, effect, solution)
- Proper identification of non-technical barriers
- Forecast based on non-technical factors (economic, social, political, etc.)

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the module.

Glossary

Grid	refers to the electric grid: a network of power generators, transmission lines, substations, transformers and other devices delivering electricity from power plants to our homes or businesses.
IoT	stands for "Internet of Things". It is a system of interrelated computing devices, mechanical and digital machines, objects, animals or people that are provided with unique identifiers (UIDs) and the ability to transfer data over a network without requiring human-to-human or human-to-computer interaction.
CES	stand for "Centralized Energy System" which refers to the centralized generation of energy (electricity) in large generating plants and its and transmission/distribution over long distances to energy consumers.
DES	stands for "Decentralized Energy Resources" which refer to a variety of small interconnected energy units.
LCOE	stands for "Levelized Cost of Energy". It is a ratio of annual power plant costs to the annual electricity production, in $/kWh or in EUR/kWh

NEDC	stands for "New European Driving Cycle". It is a predefined driving cycle designed to assess the emission levels of car engines and fuel economy in passenger cars.
CHP	stands for "Combined Heat and Power". It is simultaneous generation of both: electric energy and heat in the same production process, sometimes also called "cogeneration".
Stirling engine	is a heat engine (patented in the early 19th century) that operates by thermodynamic cycle with no internal fuel combustion (energy is acquired from external sources of heat, such as concentrated solar energy, geothermal energy, waste heat and bioenergy).
EV	stands for "electric vehicle". It is a vehicle that uses one or more electric motors or traction motors for propulsion.
IEA	stands for "International Energy Agency". It is an intergovernmental organization established in 1974, gathering 30 members from the Organization for Economic Co-operation and Development (OECD) countries, providing energy analysis, statistics and publications, including annual IEA World Energy Outlook.
DESS	stands for "Distributed Energy Storage System".
RES	stands for "Renewable Energy Sources"
O&M	stands for "Operation and Maintenance". It refers to servicing of technical systems and equipment.
CF	stands for "Capacity Factor". It is a ratio of actual annual electricity production to the maximum possible annual electricity production.
Nominal capacity	refers to declared full-load sustained power production of a power plant, sometimes also called "nameplate capacity".
Total installed costs	refers to total investment costs of the project and usually includes costs of civil works, grid connection, land, planning, wind turbine, etc.
CRF	stands for "Capital Recovery Factor". It is a ratio used to converts a present value (of total installed costs, for instance) into a stream of equal annual payments over a specified time.
Small-scale power plant	refers to a power plant with nominal capacity less than 1 MW.
SSH	stands for "Social Sciences and Humanities"
Global North/ South	Global North includes, among others, North America, Europe and Asia, and refers to developed, rich and politically stable countries. Global South refers to, among others, Africa, South America and the Middle East, which are generally developing countries, poor and politically unstable.
Prosumer	is a person who not only consumes a product e.g. energy, but also takes part in its production.

Prosumption	is a process of combined energy consumption and production. For instance, having a solar panel on the roof of one's house allows to use the energy in the household and sell the excessive energy to the energy company.
Ecovillage	is a traditional or intentional community with the goal of becoming more socially, culturally, economically, and ecologically sustainable and energy self-sufficient.
Energy democracy	is a political, economic, social and cultural concept that merges the technological energy transition with a strengthening of democracy and public participation. It's main premise is that people should be m ore involved into decision making on energy issues.
Green economy	is defined as an economy that aims at reducing environmental risks and ecological scarcities, and that aims for sustainable development without degrading the environment.
Energy transition	is generally defined as a long-term structural change in energy systems toward more environmentally friendly.

Attachment: Syllabus

1. Name of the Teaching Module

Decentralised energy systems. Social aspects of energy production and use.

2. Brief description of the subject matter

We are facing today a significant shift from classical, central and hierarchical systems of energy production and distribution, based primarily on big size power plants powered by conventional energy sources towards distributed local energy systems (DES) based mainly on renewable energy sources and smart grids solutions. The change implies not only implementation of new energy technologies, but also important social, cultural and political transformations in our societies. The goal of the course is to analyse drivers, dynamics and consequences of those complex socio-cultural trends. Focus will be put on the strategic analysis of possible futures scenarios.

3. Complete SSH problems description

A complete SSH problems description ex. bullet points, short text, mind map etc.

4. Prerequisites and context

Here we should indicate what are the prerequisites for the students to be able to take the classes. If the prerequisites are not met, this place should indicate possible ways to meet the prerequisites e.g. read a book chapter or do an online quick course. Example prerequisites: communicable English, required knowledge, required skills, etc.

5. Learning outcomes

a. Knowledge

- About current technological and social solutions and trends in energy production and distribution
- About interconnectedness of technological, social, cultural and political developments
- About main social drivers of technological innovations

b. Skills
Analysing future trends from broad SSH perspective

- Identifying possible SSH impacts of technological innovations
- Understanding complex socio-technical relations of macro and micro level energy systems

c. Social competencies

- team work
- applying group strategic analysis methods

6. Form of classes

- Lecture, seminars with presentations; group work
- Three stages (3x45min) for up to 20 students.
- At least 70% direct student participation.
- Additional self-study in-between stages

7. Teaching methods

- Concept problem presentation (power point) with brainstorming, discussion.
- Student project with Webquest, case study, analysis
- Workshops
- Scenario analysis

8. General classes plan

Session 1 Innovative technological solutions in energy production and distribution (3x45min)
1. An introductory open-form (with student interaction) lecture on innovative technological solutions of producing and distributing energy
2. Case study analysis
3. Open discussion of possible consequences (technical and non-technical) of implementation of presented technologies: from central to distributed, local energy systems.

MATERIALS: presentation, info materials related to the presented technologies

Self-study in-between: Examples of existing and potential distributed energy systems' solutions, such as:

- prosumption
- energy independent (autonomous) communities
- use of RES in DES

Assignment: students in groups of three prepare a short (5 minutes) presentation of a chosen DES-solution.

Session 2 Decentralised energy systems from SSH perspective (3x45min)
1. Presentation of the self-study assignments
2. Lecture on the shift from central to distributed DES – broad perspective, presentation of socio-political trends contributing to it (EU energy policy, green energy, energy democracy, energy as a moral resource);
3. Discussion and analysis of possible future scenarios using strategic analysis methods. (forecasting)
4. To be continued as two kinds of scenario analysis: 'Road map' and 'What if?' (explanation of the procedure and topic)

Session 3 Scenario analysis: 'Road map' and 'What if? (3x45min)
1. Scenario analysis of the given cases in groups
2. Summary discussion

9. TM assessment methods & criteria

Session 3 includes the final assignment in which the students are asked to conduct the roadmap analysis and the what if analysis. Criteria to be taken into account:

- Proper identification of barriers (cause, effect, solution)
- Proper identification of non-technical barriers
- Forecast based on non-technical factors (economic, social, political, etc.)

The proper evaluation and marks awarded for the assignment and module are subject to applicable rules of the institution hosting the module.

10. Literature and other materials

1.Scheer Herman. 2007. "Energy Autonomy. The economic, social and technological case for renewable energy". London: Earthscan.

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3.Schoor, T., Scholtens, B. "Power to the people: Local community initiatives and the transition to sustainable energy" Renewable and Sustainable Energy Reviews. Vol. 43(2015), pp. 666-675 Online: https://doi.org/10.1016/j.rser.2014.10.089

4.Adil, A.M., Ko, Y. "Socio-technical evolution of Decentralized Energy Systems: A critical review and implications for urban planning and policy" Renewable and Sustainable Energy Reviews. Vol. 57(2016), pp. 1025-1037 Online: https://doi.org/10.1016/j.rser.2015.12.079

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6.Karnouskos, S. „Demand Side Management via Prosumer Interactions in a Smart City Energy Marketplace" 2011 2nd IEEE PES International Conference and Exhibition on Innovative Smart Grid Technologies Online: http://ieeexplore.ieee.org/document/6162818/