TM2

Philosophy and Ethics of Energy Development

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

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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.

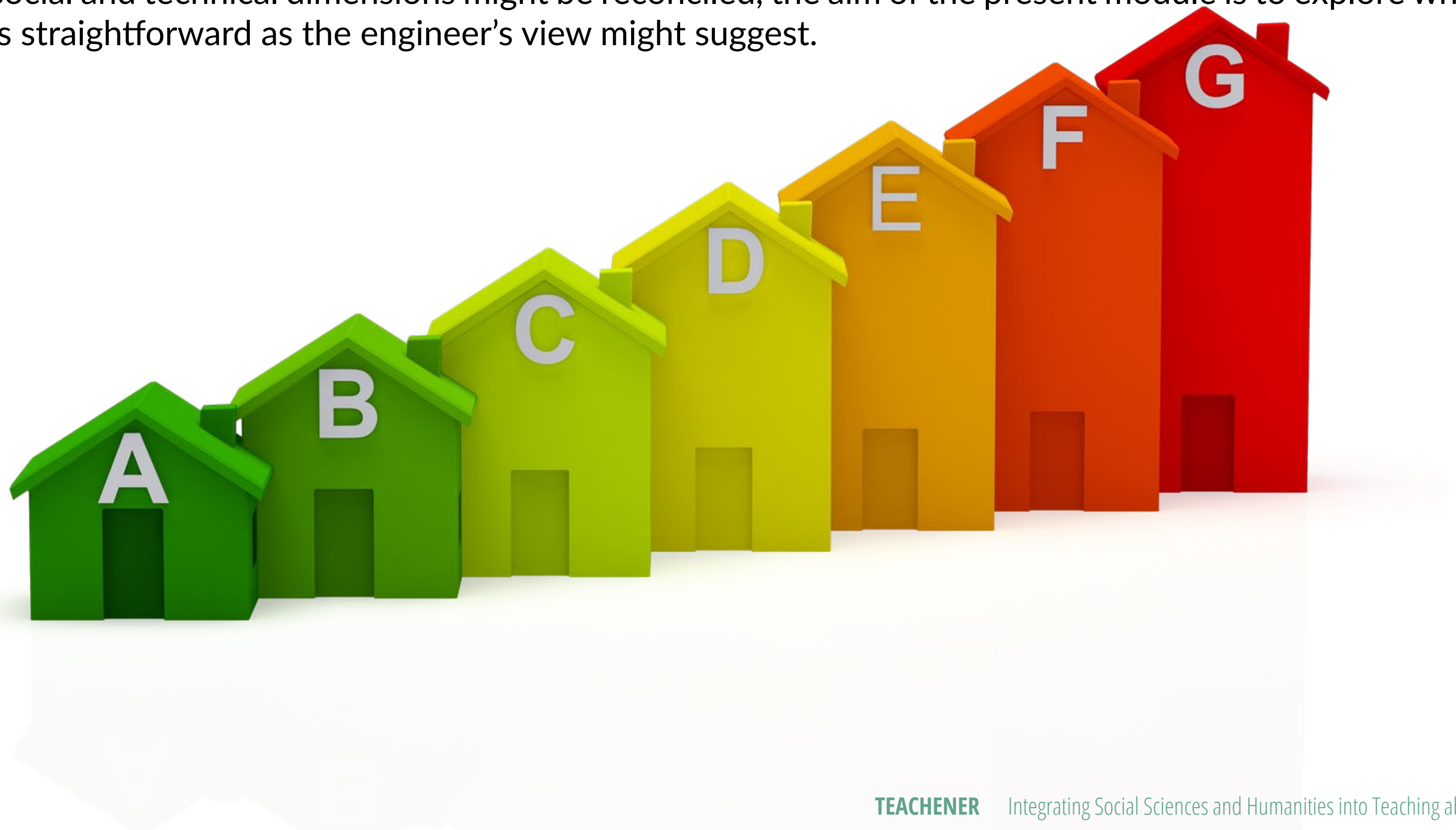
Sociological analysis of the relationship between science and technology on one side and society on the other has been intensifying steadily since the 1980'. One of the leading books of that time was the Risk Society from U. Beck (1992), which warned that even though technologies paved the way to increased 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.