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DVV International

KNOW YOUR LIFESTYLE 4

INTRODUCING SUSTAINABLE CONSUMPTION IN SECOND CHANCE EDUCATION

SUSTAINABLE ENERGY

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IMPRESSUM

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I. INTRODUCTION

In the age of globalisation, the world is moving closer together. And the buzzword globalisation does not only adhere to the boundless flow of information and capital but also the merging of cultures and a joint responsibility for the future. At the latest with the United Nations Conference on Environment and Development in Rio de Janeiro in 1992 it became clear that dwindling resources, growing environmental problems and increasing social inequalities affect the entire world and therefore all governments and societies are encouraged to bear responsibility for a viable and sustainable development.

Therefore, as well the governments of the European Union committed themselves to the basic dimensions of global sustainable development recognised in Rio de Janeiro: environmental and resource conservation, social sustainability and economic viability. Therewith, the governments acknowledge that their societies are in a learning process in which antiquated patterns of thought regarding development and underdevelopment are losing their validity and education for sustainable development must be given a more significant value. The universal responsibility of people worldwide for a socially and environmentally friendly behaviour requires a deeper understanding of the relationships between consumption patterns and the finiteness of resources, as well as an understanding of the links between consumption patterns in the countries of the northern hemisphere and the living and working conditions of people in the countries of the southern hemisphere.

GLOBAL LEARNING

Global Learning is a possible pedagogic answer to issues of global development and questions of the future. It is an educational response that is based on the principle of sustainable development and internationally binding human rights treaties.

In this interdisciplinary approach the understanding of global economic, political, social and environmental contexts is considered as a cross-cutting issue of education - an educational concept that touches all topics.

The purpose of Global Learning is to increase the understanding of the problems of the modern world and its consequences, both locally and globally. Global Learning encourages learners for a change of perspective and a reflection of their individual patterns of thought and behaviour. Such learning is important because it helps people to recognise their own role and the individual and collective responsibility they have as active members of a global society in regards to efforts for social and economic justice for all and the protection and restoration of ecosystems on our planet.

Global Learning is not a strict and regulated educational programme, but rather an open, preliminary and multi-faceted approach of contemporary general education. Global Learning should be fun. It uses a variety of interactive and participatory learning methods.

Didactically and methodologically Global Learning requires teaching and learning methods which are interdisciplinary, participatory and action- and experience-oriented, because Global Learning is both promoting cognitive as well as social and practical competencies. Thus, Global Learning does not target a particular field of knowledge, but aims at acquiring key competences and skills that people - today and in the future - need to live in a responsible, solidary and sustainable manner as world citizens ("think global – act local").

“Recognising, Evaluating and Acting” and the respective interplay of these spheres of competence are promoted. Thereby, reference is made to the living environment of the learners: Even if always one has to be careful dealing with the question of one’s own realistic capabilities and actual individual power, learners shall be enabled to analyse their own position in society, to form their own opinion and to actively participate in political processes.

SUSTAINABLE CONSUMPTION

Globalisation can be found everywhere in our day-to-day lives, starting with our shirt from Bangladesh, the cup of coffee brewed with beans from Guatemala right up to our mobile phone which would not function without coltan from the Republic of Congo.

Shopping knows no closing time, because via internet we can always purchase. Consumption imparts experience. Consumption socialises, gives meaning to our life and shapes our modern lifestyle.

Consumerism is an expression of societal development and individualism. Consumption sometimes appears as natural as eating, drinking, being mobile or working.

The media and advertising affect our consumption behaviour: products, music or outfits represent a certain style. The “proper attitude to life” and the “right perception” is organised by third parties on the market: via buying the "right products". Often, social recognition and an improvement of personal status are connected to it. Thus, in the end we all buy even things we actually do not need.

In view of a constantly growing world population and limited resources on our planet, however, the question arises how in future the needs of according to estimations by the United Nations more than 9,5 billion people in the year 2050 will be met and how participation of all people in the world can be assured. Solely the consumption of households in Europe is responsible for more than a quarter of all European greenhouse gas emissions. In this share the emissions connected to the production process of the consumer goods is not even included.

This means: the consumption of products increasingly influences both the economic and social situation of the people worldwide and the state of the environment. In the production process, in the consumption and in the use of a product lays great potential for minimising the environmental impact and for reducing global injustice. The point is to recognise and to use this potential, to hold a discussion about our lifestyles and about our responsibilities also in terms of consumption.

Of course there is the principle of “stop buying” or Consumption Renunciation. This principle focusses on the consideration whether you really need a new product or repair an old one, whether you buy a used product or make a new product by upcycling an old one.

Contrary to that, there is the concept of Sustainable Consumption (also ecological or ethical consumption). Sustainable Consumption is part of a sustainable lifestyle and a consumer behaviour itself: Buying ecologically and socially responsible products may exercise political influence on global problems. It may reduce the economic, the ecological and the social costs of our lifestyle.

A prominent example of the global dimension of purchase decisions are efforts to fair trade. Consumers should choose a more expensive good of a small producer in a developing country, thus supporting fair working conditions. As well, with a purchase decision the operating and follow-up costs of a product should be considered and decisive. This applies also to the subsequent power efficiency as well as for the repairability or the long-life cycle of a product.

Following the principle of sustainable development, consumption is sustainable if it meets the needs of the present generations without jeopardising the prospects of future generations. Sustainable consumption therefore reaches into our individual lifestyle. The sustainable consumer is the ecologically and socially responsible citizen. Sustainable consumption first of all means conscious consumption: to have a closer look and to keep in mind one’s personal "overall balance". Sustainability as a quality characteristic of products should be the guiding principle for consumers as well as for the economy and the public sector in Europe.

But how can we prepare and accompany especially young people on their way into a globalised and "connected" world in terms of viable and sustainable development? How can we convey to them the knowledge about local and global developments and challenges? How can we make them aware of sustainable options for action?

The project "Know your Lifestyle – Introducing Sustainable Consumption in Second Chance Education" would like to offer particularly young adults the opportunity to have a look beyond the horizon of their own lifestyles.

II. THE PROJECT „KNOW YOUR LIFESTYLE“

The idea for the project "Know your Lifestyle - Introducing Sustainable Consumption in Second Chance Education" was based on the fact that development education and issues of globalisation and sustainability are practically not subject of the curricula of Second Chance-education in Europe.
In cooperation with Second Chance-teachers and non-governmental organisations (NGOs) engaged in development education, the didactic materials and workshop modules in this publication on different topics of sustainable consumption such as “Renewable Energies”, “Mobile Phones”, “Water as a Global Good”, “Global Good Production in the Textile Industry” and “Human Energy” have been compiled and developed to fill this gap.
Therefore, working meetings with teachers were organised. First teaching concepts and ideas were presented to the teachers to obtain constructive feedback and detailed information regarding the characteristics of the target group and the organisational framework of Second Chance-programmes. At a later stage, in all project countries first teacher workshops were implemented to train an extended number of teachers in the use of the materials. By means of such events the participants were enabled to work with the preliminary materials themselves, to test these and already to work on the basis of the proposed topics of development education on globalisation contexts in their courses. This way, in all project countries already a certain number of project events in Second Chance-programmes could be implemented in the course of which it was possible to obtain feedback directly from the young adults enrolled in the programmes as the final target group. It was important for us to find out whether the materials were applicable in the courses and appropriate for the target audience, whether interest on part of the participants in the topics could be sparked and whether the participants enjoyed the events and the chosen methodology. According to this experience gained, the materials could again be revised and optimised.
The aim of the project is to inform young adults like the participants in Second Chance-programmes about the linkages between personal, local consumption and the global impact connected to it. It provides young adults the opportunity to look critically at individual consumption patterns and to develop alternative and more sustainable patterns of action.
The participants of Second Chance-programmes in Europe are rarely confronted with development issues in their daily lives. They are a special target group with particular learning needs: Most of them are young adults with a migration and/or difficult social background who may often experience merely little support for a sound education by their families. But with their upcoming entrance into working life they are in an important phase of their life. In the Second Chance-programmes they engage in order to improve their chances for their future. With the elaboration of the educational materials at hand we attempted to develop an innovative pedagogical approach for discussing the topic of sustainable consumption and issues of globalisation with participants in Second Chance-programmes. Of course, we hope that the materials will as well appeal to other actors engaged in various fields of education and that also other target groups will be able to work with them.
We are not claiming that the people participating in such events will be educated for becoming entirely informed and enlightened consumers. The events are designed to give participants an impetus for becoming aware of the topic of sustainability, of global connections and of the question of global justice, to put them in an informed position in case they should be in their future everyday lives be again confronted with the issue, and possibly to enable them to act consciously and sustainably in one or another future situation. All this without raising the admonishing trigger finger and appealing to their individual "guilty conscience". Awareness of sustainable consumption is a challenge, almost a science in itself in the face of the bulk of information and the complexity today’s life is providing us with,

THE PROJECT CONSORTIUM:

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DVV International is the Institute for International Cooperation of the Deutscher Volkshochschul-Verband e.V. (DVV), the German Adult Education Association. The association represents the interests of the approximately 930 Adult Education centres (Volkshochschulen) and their associations, the largest further education providers in Germany.
DVV International provides worldwide support for the establishment and development of sustainable structures for Youth and Adult Education. As the leading professional organisation in the field of Adult Education and development cooperation, DVV International has committed itself to supporting Lifelong Learning for more than 45 years. DVV International finances its work with funds from institutional and private donors.

Our Mission

Education is a Human Right. We fight poverty through education and support development. As a globally acting professional organisation for Adult Education and development cooperation, we build sustainable systems for further education along with citizens, educational organisations and governments. Together with the people in our partner countries, we establish places for Lifelong Learning.

The essential focus of our work:

- Literacy Education, Basic Education and Vocational Training
- Global Learning, Environmental Education and Sustainable Development
- Migration and Integration, Refugee Work, Health Education, Conflict Prevention and Democracy Education

Local Support

We conduct educational projects for disadvantaged youth and adults, help in the set-up of educational institutions and advise partners and governments in the establishment and development of sustainable structures for Youth and Adult Education.
We cooperate with more than 200 civil society, government and academic partners in more than 35 African, Asian, Latin American and European countries. Our country and regional offices build local and regional cooperation and ensure the quality and effectiveness of our action.

Global Partnerships

Generally, vocational, cultural and scientific education of youth and adults is a key to development worldwide. Along with national, regional and global Adult Education associations, DVV International promotes lobby work and advocacy for the Human Right to Education and Lifelong Learning. Thereby we orient ourselves on the UN Millennium Development Goals (MDG), the global Education for All (EFA) programme and the UNESCO World Conferences on Adult Education (CONFINTEA).
DVV is a member of the European Association for the Education of Adults (EAEA), the International Council for Adult Education (ICAE) and the German Commission for UNESCO (DUK).

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The Association of Adult Education Centres in Carinthia (VHSKTN) is a non-profit association with eight AECs in Klagenfurt, Villach, Spittal, Wolfsberg, Feldkirchen, St. Veit and Völkermarkt. The VHSKTN was founded nearly 60 years ago. As a traditional Volkshochschule the VHSKTN is also a member of the Association of Austrian Adult Education Centres.
The Association of the Adult Education Centres in Carinthia regards itself as educational institution and is pledged to democracy, committed to the principles of human rights and independent of any political parties. For this reason the VHSKTN is opposed to any sort of anti-democratic, racist, anti-Semitic, misogynous behaviour or which discriminates against any group of people, and it is committed to counteract such tendencies.
According to the Association of Austrian Adult Education Centres the VHSKTN view education as a learning process which continues throughout life and comprehends the cognitive, affective and physical dimensions; in other words: the whole person. Its work is focused on the learners' needs and requirements, but also tries to make people aware of needs and requirements they might forget about in everyday life.
The trainer staff of the VHSKTN consists of more than 600 trainers, who conduct more than 2500 classes every year all over Carinthia. The head of the VHSKTN is Dr. Gerwin Müller. The pedagogical director is Beate Gfrerer. Beyond traditional classes and courses around the topics culture and society, nature and environment, economy and IT, languages, creativity and culinary art and beauty and wellness the AEC association runs more than 25 local and international projects. The key aspect of most of these projects is Second Chance, beginning from the basic educational courses, the certificate of Secondary Education and University entrance examination. The Association of the Adult Education Centres in Carinthia offers a chance for those, who fall through the cracks of society and supports people from all social classes in climbing the social ladder.

SLOVENIAN INSTITUTE FOR ADULT EDUCATION

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The Slovenian institute for Adult Education (SIAE) is the main national institution for research and development, quality and education, guidance and validation, and promotional and informative activities in the field of adult education. SIAE drafts professional bases and evaluations, and monitors the development of the adult education system, develops various non-formal and formal forms of learning, develops programmes to improve adult literacy, and pays particular attention to improving access by vulnerable groups of adults to education and learning. In doing so, it develops the necessary infrastructure to support learning, develops models for the self-evaluation of quality and the validation of prior learning, and provides professional education and training for adult educators. The SIAE informs professionals and the general public about all of these processes and achievements, and contributes to the broader awareness of the importance and role of adult education.

SIAE's mission in detail:
We believe education could help people in exploring their life-long question i.e. “How should I live my life?” In this way the voice of the learner needs to be heard in the curriculum. On the other hand person could not be realised out of the community. Even more - every person tends to be realised in the community. Education shall bridges those two sides of human life. The word community is derived from the Latin word “communicare “that means to communicate, to share. Communication means sharing - not only the material things, but also

knowledge, spiritual things, values, problems etc. People need to communicate. The problems they share, even the conflicts might be understood constructively when there is a place for dialogue, where human ideas, knowledge and competences, virtues and values might be exposed and discussed. Dialog means that people hear each other and try to understand each other. When people understand each other, they may be willed to construct common reality. Thus SIAE puts special attention to the community's learning, dialogue and to the personalization of learning. In this process our special concern is paid to adults who are in dangerous to be excluded from dialog e.g. low educated, young dropouts, migrants, unemployed, etc. Most of our work refers to non-formal learning that represents the major part in human lifelong learning.

SIAE and adult educators:
We are aware of the importance of competent staff in adult education and thus we develop learning programs for adult educators (teachers, mentors, tutors, counsellors, advisers, etc.). They represent the cornerstone in the quality of learning process and thus important agents in changing society.

SIAE and the project "Know your Lifestyle":
It hasn't been difficult for us to decide to cooperate in the project "Know your Lifestyle", because it grows from similar values and has very similar aims as we have already write above. The questions of sustainable consumption are very important in the global world. We believe we can help to spread the principle of sustainable consumption in Slovenia. We have stepped in the project together with the network of PUM[1] mentors and Umanotera - the non-government organization who has already worked at this field for more than decade. We all learn together with other partners in the project. We communicate and share all the goods, knowledge and ideas in striving to disseminate them world widely.

ESTONIAN NON-FORMAL ADULT EDUCATION ASSOCIATION

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The Estonian Non-formal Adult Education Association (ENAEA) is non-governmental, national umbrella organisation in the non-formal adult education field associating education-orientated NGOs and folk high schools. ENAEA has 72 member organisations.
Our values:
- Life-long learning and every person's active participation in his/her own community's as well as in the state's life as a whole is a necessary precondition and resource for development;
- Learning plays a key role in softening poverty, inequality and social stratification, but also in supporting democracy, creativity and economical development.

According to the ENAEA's standpoint, the life-long learning in Estonia has to guarantee taking into account the learners' needs and participants' active involving in study process and assure the accessibility of learning possibilities to all applicants.

ENAEA is active in adult education policy; supports activity of its members, promote their mutual relations; collects and publishes educational materials; collects and distributes information; carries out research projects; organizes seminars, courses, conferences etc.; cooperates with organizations having similar objectives in national and international level; cooperates with governmental institutions.
ENAEA has experience in different research and network projects: EQF, NQF, adult educators' profession and qualification issues (national and international level, incl. training of trainers), basic skills and vocational education, key competencies and non-formal education etc.
The competence areas are: adult education in local areas; NGO leader training; guidance and counselling in adult education; quality of adult education (incl. training of trainers); involving school dropouts (young adults) into adult learning activities.

[1]PUM ist eine slowenische Abkürzung für ein Programm des zweiten Bildungswegs, d. h. Projektlernen für junge Erwachsene, das bei SIAE in den 90-er Jahren entwickelt wurde, um jungen Ausbildungsabbrechern helfen, Bildung zu erwerben oder eine Arbeit zu finden. Heute gibt es 12 PUM-Gruppen in Slowenien.

EUROPEAN ASSOCIATION FOR THE EDUCATION OF ADULTS

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EUROPEAN ASSOCIATION FOR THE EDUCATION OF ADULTS

The European Association for the Education of Adults (EAEA) is the voice of non-formal adult education in Europe. EAEA is a European NGO with 123 member organisations in 42 countries and represents more than 60 million learners Europe-wide.

EAEA is a European NGO whose purpose is to link and represent European organisations directly involved in adult learning. Originally known as the European Bureau of Adult Education, EAEA was founded in 1953 by representatives from a number of European countries.

EAEA promotes the social inclusion aspects of the EU 2020 strategy; it promotes adult learning and the widening of access and participation in formal and non-formal adult education for all, particularly for under-represented groups. We promote learner-centred approaches that take people's lives into account and enable them to acquire all kinds of competences, with particular attention to basic & transversal skills.

EAEA

- provides information & briefings on EU policy
- cooperates with EU institutions, national & regional governments, e.g. the Council of Europe & UNESCO
- cooperates with stakeholders, through EUCIS-LLL
- releases reports, handbooks, project information & results
- provides advice and recommendations for our members' policy work
- helps members with exchange of good practice, partner search & dissemination of projects & events

EAEA aims to support and disseminate their member´s engagement in activities, partnerships, policy and curricula development, research and provision for social inclusion and cohesion, democratic participation and combating poverty and discrimination. Linked to an international network of adult education providers, EAEA is leading in mainstreaming innovative concepts in adult learning. EAEA regularly organises European conferences on topics relevant to Adult Education and LLL and links to other European platforms and umbrella initiatives on European level.

Furthermore, EAEA has a long expertise in dissemination activities and powerful dissemination channels: through its website, it reaches 350000 unique visitors in a year; its newsletters counts more than 2000 readers and its social media are followed by more than 800 people.

THE AUTHORS OF THIS VOLUME: TARTU ENVIRONMENTAL EDUCATION CENTRE

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Tartu Keskkonnahariduse Keskus

The Tartu Environmental Education Centre is a diverse, open and friendly organisation. Both children and the environment are important to us.

We wish to promote a long-lasting and environmentally friendly way of living from generation to generation in Estonia. We hope that people will notice and care about the nature around them.

We believe that we can spark interest to increase responsibility and awareness towards nature. We wish to introduce and promote environmentally friendly ways of living to children, young people and adults.
All our programmes bear this idea and all our teachers and students know that every single action may change the world

III. INFORMATION ON THIS VOLUME

This volume of materials on sustainable energy provides an overview of why the world of energy should switch from fossil fuels to sustainable energy sources, and what options we have for energy saving measures and for the production of renewable energy.
The materials consist of chapters with a text and exercises. The first chapter explains why there is a need to change our consumption of fossil fuel (environmental and social problems, climate change). The second chapter gives an overview of energy and climate policies, how decisions are made regarding sustainable energy and where the world is heading to. The third chapter explains the importance of energy saving with regard to energy efficient housing and explores what students themselves can do. Chapters four to eight deal with renewable energy. The main types of renewable energy are explained. For every energy type there is a summary of the current situation, the production methods and environmental questions.
The materials can be used for a special learning event, e.g. a one or two day course about sustainable energy. There is a proposed schedule for a one day event, but of course the materials can be used according to a facilitator‘s and participants’ needs and wishes. Individual parts can be used for specific classes as well. For example, the first two chapters („Why do we talk about sustainable energy and „Energy policy“) can be used in social studies or civic education. Other chapters can be used in natural science (biology, physics, geography), as well as in social studies.
Simple tasks suitable for a basic level are marked with one star * and more difficult tasks are marked with two stars **. Some tasks are meant for both target groups and marked */**.
The methods are always described in such manner that an independent and easy implementation by the teachers should be possible. As already implemented events have shown, however, in some cases for a successful application and for having a joyful event a certain amount of improvisation on sides of the teachers is necessary and sometimes even intended.
Information on the materials respectively needed for implementation and on the amount of time required (the respective information concerning the time are meant as a guideline and may vary depending on the characteristics of the group) as well as instructions regarding the preparation, implementation and evaluation of an event is always listed. Copy templates and worksheets which are to be used are respectively provided. These may be copied out of this publication. Since the materials may be also found in the download section of our project website (www.knowyourlifestyle.eu), the printing of single contents may ease the process of preparation.
We hope that all teachers and their course participants who jointly work with our materials will enjoy the examination with the issues proposed, that they will gain fascinating insights and ideas and that they will take a strengthened awareness of sustainability into their future lives.

EXAMPLE OF A ONE DAY WORKSHOP

6 – 6,5 academic hours excluding breaks. The actual schedule depends from participants' background and goals of the workshop.

time/minutes	title	activities	content	materials/ documents
10	Introduction into the day	Presentation of the workshop and topic: why do we talk about sustainable energy?		
45	Fossil fuel-based world	Five hats	What the main fossil fuels are potential problems concerning the fossil fuels	5 paper hats: white; red; blue; black
90	Problems in connection with the use of fossil fuels	Lecture; reading Discussion in groups	How the fossil fuels have arisen and why these called non-renewable resource. The influence of the extraction of natural resource to peoples lives and the wildlife.	Papers with text A5 sheets; colour pencils, pastels or crayons; Internet access Optional: worksheets (to fill the table)
45-60	Global warming	Fishbowl	The reason and consequence of climate change	Option 1: Teacher introduce the content before "Fishbowl", handouts with short text Option 2: Participants read the text and additional information from the internet: handouts with text and internet access.
90	Global warming: how climate change effects the world	Lecture, collage	What can happen as the climate warms	Handouts with statements; White papers (A4); magazines with pictures/ photos; scissors; glue

1. WHY DO WE TALK ABOUT SUSTAINABLE ENERGY?

>>> FOSSIL FUEL BASED WORLD - FIVE HATS */**

Group work; presentation; discussion

45 Min.

5 paper hats: white; red; black; blue; yellow

Participants can name the main fossil fuels. Participants can outline the potential problems concerning fossil fuels.

Divide the group into five smaller groups; each group gets a topic for discussion; each group chooses aleader who gets a hat in a different colour; the group takes the position that corresponds with the colour of the hat/task.

- White indicates objective facts, figures and information, arguments presented in a business- like manner.
- Red shows emotions and feelings, filled with positive and negative emotions .
- Black reflects unsolvable and complex problems, expressed in a negative, pessimistic way .
- Blue approaches everything with restraint and control, listening closely to other participants. .
- Yellow is full of optimism and hope for the future, positive, constructive.

Discuss the following topics:

1) Fossil fuels have provided us with fast and relatively easily accessible energy. The main fossil fuels are oil, natural gas, coal, lignite and oil shale. Their use has led to the rapid development of our society, but it has also led to a number of problems. Discuss problems caused by the extraction and use of fossil fuels and give examples. What type of energy is used in your country? Where does the electricity for your home come from? What do you use for heating? What is its environmental impact?

2) Imagine what would happen if at some point there would no longer be any oil. If one is very dependent on something (in Europe, after all, our fuel consumption is dependent on foreign countries), then one is also very vulnerable. For example, in Britain in the year 2000 there was a strike against rising fuel prices, where truck drivers blocked several key fuel distribution places. This caused panic across the country; many petrol stations ran out of fuel, a number of schools were closed; stores began running out of food because the supply of goods was interrupted, etc. What would happen if oil would disappear for a day, a week or a month?

Or if all the fossil fuels would disappear - would humanity be able to develop new technologies fast enough to replace them?

>>> PROBLEMS WITH FOSSIL FUELS**

Participants identify the origin of fossil fuels. Participants explain why fossil fuels are called non-renewable resources. Participants decsribe how the extraction of natural resources impacts on wildlife. Participants outline how the extraction of natural resources impacts on peoples' lives.

Group work, presentation, discussion, manual activity

90 Min.

4xA5 paper; coloured pencils, pastels or crayons; Internet access

This task targets more advanced students. However, without any extra material, it can also be used for less advanced students.
Divide the class into four groups and give each group one of the following topics. The students read the introductory text and discuss it in the group. Each group draws a picture representing their researched topic (30 min),
Then they present it to the other groups and it is discussed jointly (45 min).

The texts are only a brief introduction to the topic and the students can expand the topic according to their knowledge. For each topic, there is extra reading / viewing if necessary. This requires a computer and internet access and additional time.,.
For topic 4 there is an additional exercise "Fill in the table". The facilitator can choose where this exercise fits in..

>>> GROUP WORK: WHAT IS IN STORE FOR YOUR COUNTRY?*

Participants name how global warming can influence their own life.

group work, discussion

45 Min.

Flipchart; notepaper; pencils

Step 1:
students discuss in pairs the following questions and write down the results.. Every pair writes down 3 points per question (3 x 6 notepapers)

- Have you heard what is predicted for your country/region?
- Have you noticed a change in climate already?
- Was there usually more snow in winter or sun in summer, did spring arrive later, or have a few species which were common in the past become rare?

If you have time, ask your parents or grandparents about the weather when they were young. Do you notice a difference?

Step 2:
two pairs (4 students) share the results of their discussion and find common points. They keep the notepapers with those answers that all group members accept.

Step 3:
8 students (2 x 4 students) share the results of their discussion and find common points. The same procedure as above applies.
This process can be repeated until the entire group is together. Then all questions must be written on a flipchart and notepaper. All group members have to decide what will be added..
The result of the group work will be discussed shortly. During the discussion the facilitator acts as moderator.

>>> COPY TEMPLATE

PROBLEMS WITH FOSSIL FUELS

1. NON-RENEWABLE NATURAL RESOURCES

Fossil fuels are a non-renewable natural resource. They are a result of the incomplete decomposition of living organisms which has taken millions of years. For humankind, this means that within the real timeline no new resources will be created and that we have to take into account their finality.. Assuming easily extractable mineral deposits may become depleted, we must introduce new technologies. Mining may become increasingly more expensive, more difficult and in some cases even more dangerous to people and the environment.

There is a lot of talk about the oil peak - this is the moment when output has reached its apex with existing resources and technology and from that point on the amount of oil produced will decrease daily and production will become increasingly costly and complex. A few years ago, it was expected that the peak would be coming very soon, but apart from conventional oil extraction, new technologies for extraction of different fuels such as oil sands and shale gas have been developed, which has extended the life of the oil era. According to one theory, the evolution of technology will guarantee the world's demand for fossil fuels. This, however, requires constant expensive investments for developing technologies that equip us to harness resources that are more and more difficult to obtain. The opposition that environmentalists put up and the conflicts with climate objectives also have to be considered., At some point, investing in these technologies will probably no longer pay off. The future cannot be predicted. However, anyone can form their own opinion by just researching the existing facts.

Do you think that people will continue to find new resources , or should we look for long term alternatives?

Read more:Michael T. Klare "Peak Oil Is Dead!Long Live Peak Oil!" Huffington Post (09.01.2014) www.huffingtonpost.com/michael-t-klare/peak-oil-is-dead_b_4567978.html

2. NATURE CONSERVATION AND PROTECTION OF THE ENVIRONMENT

Almost any extraction of a natural resource has an impact on wildlife. Fossil fuels are usually mined deep in the ground using sophisticated technologies. In the process a variety of chemicals are used, leading to a risk of contamination and leakage.
In 2010, the largest oil spill in the aquatic ecosystem occurred in the Gulf of Mexico. -An oil rig exploded, and it turned out to be very difficult to stop the resulting oil leak. It took 87 days until the oil leak could be stopped. It was a huge environmental disaster, nearly 5 million barrels of oil ended up in the ocean , of which only a total of 800,000[1] was removed. The oil spill caused irreparable damage to wildlife and lead to huge financial loss.

Nature conservation issues and problems are related to the extraction of all fossil fuels. Are you aware of the various environmental problems associated with fossil fuels? For example:

- Oil sands in Canada
- Oil drilling in the Arctic
- Shale gas extraction (via hydraulic fracturing)

Has there been any oil disaster in your country or close to you? How was it handled and what kind of damage did it bring to nature? Is your country sufficiently prepared for an accident?

In addition: See The New York Times' interactive website on the pollution of the Gulf of Mexico (the affected areas, damage to wildlife, causes of the leakage, stopping the leak, etc.) http://www.nytimes.com/interactive/2010/05/27/us/20100527-oil-landfall.html?_r=0
Watch the video on the impact of oil spills on wildlife: http://youtu.be/aYCSmhrcrT0
More on the oil sands in Canada: Read the article in National Geographic „Scraping Bottom: 'The Canadian Oil Boom" (03.2009) http://ngm.nationalgeographic.com/2009/03/canadian-oil-sands/kunzig-text
Watch the video http://vimeo.com/7408834

[1] Robertsin, C & Krauss, C. Gulf Spill Is the Largest of Its Kind, Scientist Say. The New York Times. 02.08.2010. www.nytimes.com/2010/08/03/us/03spill.html?_r=2&fta=y&

3. INDIGENOUS PEOPLE AND VALUABLE LAND

The fossil fuel business employs many people and, more broadly, may provide economic benefits and wealth for the country on whose land the reserves are located. Often, however, the very people who have lived on the land do not benefit. Instead, individuals who are related to business profit the most. In the interest of mining, communities are displaced and valuable ecosystems are destroyed. Mineral and natural resources often cause conflicts of interest between indigenous people and conservationists.
For example, it was decided to start extracting oil in Yasuni National Park in Ecuador, which is a centre for biodiversity (i.e., an area that is home to many rare and highly endangered species,), and the residence of a tribe of indigenous people who want to continue living in their traditional way. This includes the tribe's voluntary isolation, avoiding any form of contact with the outside world. A major development would inevitably lead to a Western life-style (which is only acceptable if locals want it). Roads are constructed through the rainforest, which in turn attract people from outside who want to take advantage of the resources (e.g., illegal loggers). The pressure on the local way of life and the environment is rapidly increasing.
Can you think of some examples from your home country where residents' rights have been violated in the context of fossil fuel extraction? What is more important: the country's overall well-being, or the rights of the aboriginal people and

On the population and the problems of Yasuni National Park in relation to oil drilling.CNN 01.03.2014. Antonia Juhasz. Opinion:Why oil drilling in Ecuador is ‚ticking time bomb' for the planet. http://edition.cnn.com/2014/02/28/opinion/ecuador-rainforest-oil-exploration/

4. AIR POLLUTION

The use of fossil fuels leads to emission of carbon dioxide into the atmosphere. Co2 is a completely conventional ingredient, comprising about 0.04% of the air. However, the rapid growth of its concentration is a problem, leading to an increased greenhouse effect and global warming.
However, we should not forget that when using fossil fuels a number of other compounds are released into the air that directly affect our environment much more - such as carbon monoxide (CO), sulphur dioxide (SO 2), nitrogen dioxide (NO 2), nitric oxide (NO), hydrocarbons and others. Different compounds cause damage to health (e.g., respiratory diseases), and wildlife (e.g., acid rain). The resulting pollution is most visible in cities with a high density. Fossil fuels are used for transport, industry and energy production. In extremely polluted cities, sunshine is a special event as thick smog often covers the city.

What problems can be caused by different atmospheric compounds? Complete the table. Guidelines for filling in the table:

Name:
several different, here benzene // several different //ozone// carbon monoxide, // several different here Mercury // nitrogen dioxide // here nitrogen dioxide

Cause:
on incomplete combustion of fuels, including car exhaust gas // car exhaust gas // volcanic eruptions and burning of fossil fuels // in sunlight with NOx, CO and volatile compounds react // 3x the combustion of fossil fuels (e.g., automobiles, thermal power plants)

Harm:
heart disease, lung cancer // acid rain (HNO3 formed), toxic, causing poisoning // carcinogen, causing poisoning // harmful to nervous system // acid rain (H2SO4 formed), respiratory diseases // odourless and colourless but toxic, , causing poisoning, as CO binds to haemoglobin in the blood instead of oxygen molecules

>>> COPY TEMPLATE PROBLEMS WITH FOSSIL FUELS

Component of air pollution	Name	Cause	Harm
CO			
SO2			
NOx (NO, NO2)			
Volatile Organic Compounds			
O3			
Fine particles			
Heavy Metals			

Solutions:

Component of air pollution	Name	Cause	Harm
CO	carbon monoxide	Caused by incomplete combustion of fuels, including in car exhaust gas	odourless and colourless but toxic, causing poisoning, as CO binds to haemoglobin in the blood instead of oxygen molecules
SO2	sulfur dioxide	Caused by volcanic eruptions and burning of fossil fuels	Acid rain (forms H2SO4), respiratory diseases
NOx (NO, NO2)	Here nitrogen dioxide	By combustion of fossil fuels (in cars, in thermal power plants)	Acid rain (forms HNO3), causes poisoning
Volatile Organic Compounds	a number of different ones, here, benzene	in car exhaust gas	carcinogen causes poisoning
O3	Ozone	in sunlight NOx, CO and volatile compounds react	component of smog, respiratory irritation and lung damage, shortness of breath, asthma
Fine particles	A number of different ones	By combustion of fossil fuels (in cars, in thermal power plants)	heart disease, lung cancer
Heavy Metals	Here Mercury	By combustion of fossil fuels (in cars, in coal power plants)	detrimental to the nervous system

>>> COPY TEMPLATE GLOBAL WARMING: TEXT

While there are sceptics, the majority of countries and scientists in the world agree that global warming is a serious problem, and that people are responsible for it.. It does not pay off to take any risks with such an important issue. We must assume that it is important to reduce greenhouse gas emissions. The energy and transport sector play a big role in this, because burning fossil fuels emits large amounts of carbon dioxide into the air, which is the most important greenhouse gas (carbon dioxide accounts for about 80% of the greenhouse gas impact of the European Union)[2]. In addition, greenhouse gases are caused, e.g., by livestock farming and changes in land-use (e.g., draining of swamps, logging of forests).

Often, for the common description of all the greenhouse gas emissions, the term CO 2 equivalent is used. , The gases are calculated into a single system, taking into account their impact on global warming. Different gases have different global warming potentials; CO 2 is arbitrarily taken as 1 and the life span of the other gases in the atmosphere and the ability to retain heat has been compared with that. While the climate warming potential of other gases is many times greater than that of carbon dioxide, , their quantities in the atmosphere is fortunately much smaller. The greenhouse gas with the biggest impact and concentration is in fact water vapor, but we have no control over it.

Internationally accepted and reliable information can be received from the IPCC. The IPCC (Intergovernmental Panel on Climate Change,) explores scientific aspects related to climate change and brings together independent scientists from around the world. Their report appears about every 5-6 years and is based on the results of their research; independent scientists from around the world put together the best available information relating to climate warming. The IPCC 2013 Summary report[3] states: 'it is very likely that human influence, which started from the mid- 20th century, has been the main reason for the apparent warming. Also, the concentrations of greenhouse gases CO2, CH4, and N2O are exceptionally high compared to at least the last 800,000 years and the concentration of carbon dioxide has increased by 40% compared to the period of the industrial revolution (by 0.8 °C)'.

What does climate warming involve? Of course the increase of the earth's average global temperature is especially apparent in the Polar Regions. People most affected are the poor in developing countries, situated in areas where hazard incidents are likely to increase even more (droughts, floods etc.). Residents from poor countries struggle to prepare for the effects of climate change and often lack the resources to adapt to it. In developed nations in Europe and North-America the climate situation remains tolerable, effects are less visible, although they are not untouched.

Of course, not all natural mechanisms that are associated with global warming are yet known Maybe something will be discovered that will keep global warming under control by natural means? But there is also a lot of talk about feedback mechanisms that may take place that will accelerate global warming Although even the best researchers are not able to predict the future with absolute certainty, the danger signs are obvious. Many changes are already visible and much worse is yet to come. Even if the concentration of greenhouse gases in the atmosphere does not increase from now on, the changes and warming would continue for a long time. At present, in the world there is a common agreement that we need to keep global warming below 2 °C in order to avoid serious consequences.

Read more from The Guardian:
Questions and answers on the climate issue http://www.theguardian.com/environment/series/the-ultimate-climate-change-faqBlog Climate Consensus – the 97%http://www.theguardian.com/environment/climate-consensus-97-per-cent
See the map in National Geographic on the predicted consequences of global warming: http://environment.nationalgeographic.com/environment/global-warming/gw-impacts-interactive/

[2]EEA Technical report No 8/2013, Annual European Union greenhouse gas inventory 1990-2011 and inventory report 2013; http://epp.eurostat.ec.europa.eu/cache/ITY_PUBLIC/8-29052013-AP/EN/8-29052013-AP-EN.PDF
[3] IPCC. Climate Change 2013. The Physical Science Basis. Summary for Policy Makers. http://www.ipcc.ch/report/ar5/wg1/docs/WGIAR5_SPM_brochure_en.pdf

>>> GLOBAL WARMING - FISHBOWL **

work with text, discussion

60 Min.

Internet access

Participants can name causes and consequence of climate change.

The Fishbowl method allows for a richer discussion of the topic and helps to focus the attention on ways in which the group might work together more productively.

Step 1:
participants read the text below (20 minutes). In case there is more time and internet access is provided, the facilitator gives additional material to read.

Step 2:
5 chairs should be put in the middle of the room and the facilitator asks for 4 volunteers or might select students who are fairly skilled at group discussions to sit on the chairs. One chair remains empty. This small group will conduct a discussion while the rest of the students standing around, watch, take notes and later pose questions and give comments about what they observed. To get the discussion going, the facilitator offers an open-ended question. If a student who is observing wants to speak, he/she should move to the vacant seat and join the discussion until someone else from outside the circle wants to join. That person then taps the first person on the shoulder, and they quietly switch places. (20 minutes)

Step 3:
the facilitator asks the members of the outside circle to add their comments, so that everyone can discuss what happened. The session might end with a discussion that includes the entire class about what they learned and how it applies to future discussions. (20 minutes)

>>> IMAGING A FUTURE CLIMATE - COLLAGE *

Participants identify what can happen regarding climate warming

Lecture; creative (manual) activity; presentation; discussion

90 Min.

White paper (A4); magazines with pictures/photos; scissors; glue

Step 1:
Using the text and additional material from the internet, the facilitator gives a short lecture on global warming. Then he/she asks students to think about the effects they have heard about. For example: "What does global-warming mean for the future?" The facilitator can use the following statements as examples:

- Shrinking ice cover in the Arctic
- The North Pole snow cover period is becoming shorter
- Glaciers are dwindling
- Permafrost begins to melt
- As the ocean temperature rises, changes in the ocean's currents occur
- As the ocean gets warmer, fixed carbon may start to be released (current accumulation of carbon into the deep ocean holds back the atmospheric warming to some extent, but this may change)
- Sea levels will rise (due to thermal expansion), and a number of land areas (including high-density cities) will be flooded
- More frequent extreme weather events (e.g., storms, droughts)
- The reduction of biodiversity (many species are unable to adapt to such rapid change)
- In each area, the changes are different. Estonia, for example, is predicted to become warmer in future, but also will get more rain.

Step 2:
Students make a map of the world indicating how it would be according to the predictions using collage techniques. Students use their imagination and results can be very different (drowning polar bears, melting of ice or sea level rise, showing poor people hungry etc.) After students have had some time to think, the facilitator can initiate a discussion and help them by adding missing effects.

Step 3:
After finishing the map, students present it to the group and explain why they have chosen particular images.

HOW CLIMATE CHANGE AFFECTS THE WORLD - COLLAGE*

Participants know what can happen regarding climate warming

creative (manual) activity;

90 Min.

White paper (A4); magazines with pictures/photos; scissors; glue

The same method as described above but the focus is on the whole world: aim to see and understand the inequality between the global North, who is the main cause of climate change, and the global South, who will suffer the consequences..

>>> ENERGY AND CLIMATE POLICY

The first global attempt to enter into intergovernmental agreements to prevent climate change was made in 1992 in Rio de Janeiro, where the United Nations (UN) Framework Convention on Climate Change was signed. In 1997 in Kyoto, a protocol was adopted, aimed at the reduction of hazardous emissions. It was not signed by a number of key countries such as the U.S. and Russia and therefore the protocol came into force only in the year 2005. By 2013, some countries complied with it, but many have also retreated. The Protocol applies until the year 2020, and currently negotiations are ongoing for signing a new agreement. Every year, representatives of all countries come together at the UN climate conference, where politicians sign agreements between countries and set goals for the future. Currently an agreement that can be ratified in 2015 is prepared and is meant to be implemented by 2020, when the obligations of the Kyoto Protocol expire[4].

Nature conservation organisations are often dissatisfied with the results of the meetings because the progress is too slow to halt global warming effectively. In 2013 at the Warsaw Conference, non-profit environmental organisations decided to withdraw in protest, as in their opinion the progress was too slow and not ambitious enough.

Read more about this from The Guardian, for example Green groups walk out of UN climate talks.

Read more on the Framework Convention on Climate Change and the Kyoto Protocol at: unfccc.int/kyoto_protocol/items/2830.php

European Union aims - 20/20/20

About 11% of CO_2 caused by humans globally is emitted by the European Union[5]; the EU has set quite significant targets to stop global warming. The general objectives of the European Union for the year 2020:

- reduce greenhouse gas emissions by 20% compared with 1990 levels (by 2030 is planned to reduce greenhouse gas emissions by 40% and 2050 by 80-95% compared to the level of the year 1990)
- achieve a 20% proportion of renewable energy in consumption and 10% in the transport sector
- reduce energy consumption by 20%[6]

Look for more information on the European Union‘s climate policy: ec.europa.eu/clima/policies/brief/eu/index_en.htm

Each country has established internal targets, which are based on the general agreement of the European Union. For example, Denmark’s target is to reduce greenhouse gas emissions by 40% by the year 2020 compared to the year 1990 (compared to the EU‘s overall objective of -20%), and by 2050 to switch to 100% renewable energy (in the field of electricity, heating, transport and industry). Estonia was, in 2013[7], the first European Union country, that set for itself the goal to achieve a 25% renewable energy share of total consumption by 2020.

Discover more: www.carbonfootprintofnations.com

Finally, while energy policy is focusing on stopping global warming, we should remember to see the big picture and not forget all the other problems associated with fossil fuel use

[4]UNFCCC homepage. Kyoto Protocol. http://unfccc.int/kyoto_protocol/items/2830.php
[5]European Commission homepage. Climate Action. http://ec.europa.eu/clima/policies/g-gas/index_en.htm
[6]European Commission homepage. Climate Action. http://ec.europa.eu/clima/policies/package/
[7]Danish Energy Agency homepage. Danish Climate and Energy Policy. http://www.ens.dk/en/policy/danish-climate-energy-policy

>>> WORLD CAFE**

Participants know about the United Nations (UN) Framework Convention on Climate Change. Participants know about the Kyoto Protocol. Participants know about the European Union energy policy.

Lecture; presentation; discussion

60 Min.

Large room; 4 tables for discussions; paper; pens

Step 1

The facilitator gives a talk about energy and climate policy. A discussion using the World Café process will follow.

Step 2

4 tables are needed for 4 topics (see below). Every student chooses a table . The size of the group will determine how many students will be around a table. Discuss the following topics in smaller groups and then let the others know the results you achieved.

Table 1

The European Union has set the global benchmark in terms of its CO2 emissions reduction and increased the share of renewable energy. At the same time, a number of other major emitters like the U.S., India and China do not follow suit and set less ambitious goals. Even if Europe meets its goal, it is difficult to keep climate warming within the limits of 2 °C in the global context which is considered important in order to avoid the dangerous effects of global warming.
Questions to be discussed: Is the European Union right in trying to fulfil its goal ? What could be the reasons that other big polluters do not want to set such strict goals? How can the problem be solved?

Table 2

Emissions trading or sale of CO2 quotas is a system introduced by the Kyoto Protocol. In this framework, countries which are unable to adequately reduce their greenhouse gases can buy shares from those countries who have already reached their target and who have more quota than they need. Trade is designed to ensure the overall reduction in CO2 emission , although each state is not required actually to fulfil their target.
Questions to be discussed: Is this buying and selling legitimate, or should each country individually be able to reach their target? Estonia received a lot of revenue from trading,. Can this be justified?

Table 3

Developed countries have achieved their current level of development largely by using massive amounts of fossil fuels in the 20th century.
Questions to be discussed: Does this give developing countries the right to use fossil fuels to the same extent, in order to reach the level of developed countries? Or, should they immediately switch to a green economy and keep their greenhouse emissions under control?

Table 4

The targets for reducing greenhouse gas emissions have been put in place, but it is up to individual countries to decide how to carry out these objectives.
Questions to be discussed: What would be efficient ways to reduce greenhouse gas emissions in your country? What is your country already doing and what more could it do?

Each student participates in every discussion (table). 1 (table) session lasts 10 minutes. The facilitator chooses the note taker who also reports back. The note taker collects information from all sessions and presents this to the group after the discussions.

>>> DEBATE IN TEAMS**

Participants understand the global effect of the massive fuel consumption

Group work; debate

60 Min.

The topic for debate is: “Is life without fossil fuels possible or must we accept the consequences of their use in order to preserve our society?”
The facilitator divides the class into 2 teams. Team 1 prepares arguments for the use of fossil fuel, and team 2 prepares arguments against it.

After the debate the teams change and team 2 prepares arguments for the use of fossil fuel, and team 1 against it.

Changing positions gives students an opportunity to see the same argument from another point of view.

3. ENERGY EFFICIENCY

The demand for energy is increasing every year (particularly in emerging countries, led by China and India)[8]. In order to move towards a sustainable energy economy, it is important to think about efficient energy use. Heating the air is not exactly a wise idea, but right now exactly this is currently done by many power plants. In cold climates, it is important to build thermal power plants which in addition to producing electricity can make use of the heat generated(e.g., district heating).. Good insulation of buildings is also important, because in cold climates significant amounts of energy are used for heating.

Our energy needs could be much lower at the same standard of living. Many new solutions are already available, but as always, remodelling old systems is time-consuming and changing mindsets is difficult.

3.1 Energy saving

The most environmentally-friendly and cheapest energy is unconsumed energy. Energy consumption largely takes place in every day life. In homes, energy can be saved in different ways by using energy efficient electrical appliances, insulating living spaces well, taking care of your electricity consumption and energy use, etc.

The European Union has put in place energy efficiency classes, with A + + + being the most energy efficient and G the most energy consuming product. The goal is to help consumers to choose a product according to its energy use[9]. Energy use tracking devices can be installed in homes. Trying to be more conscientious is a very easy way to save energy. (instead of reducing spending).

See the picture of energy efficiency classes: www.newenergylabel.com/index.php/uk/home/

Energy Efficient Building

Article 9 of Directive 2010/31/EU of the European Union stipulates that by 31 December 2020, all new buildings will be nearly zero-energy buildings and after 31 December 2018, new buildings occupied and owned by public authorities are nearly zero-energy buildings. What, however, is a nearly zero-energy building? No specific numerical criteria have been established here. Overall, though, it is a building where energy efficiency is very high. The small amount of energy needed should largely come from renewable sources, which could be produced on-site or nearby[10].

An energy efficient building does not only retain heat well. A well-built energy-efficient building has to be comfortable for people. In summer, this building must effectively maintain cool temperatures and provide fresh air and adequate moisture levels all year round, as well as good lighting conditions. According to European standards, low energy houses need less than 40 kWh/m2 per year for heating and just 15 kWh/m2 per year for passive heating. Compared to existing old buildings, that require 220 kWh/m2 per year for heating, the saving is significant[11].

[8]Enerdata homepage. http://yearbook.enerdata.net/#energy-consumption-data.html
[9]EU New Energy Label homepage. http://www.newenergylabel.com/index.php/uk/home/
[10]DIRECTIVE 2010/31/EU OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 19 May 2010 on the energy performance of buildings http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:153:0013:0035:EN:PDF;
[11]Mauring, T., Hallik, J., Siiner, A., Valge, M. 2009. Passivmajatehnoloogia. Kvaliteedi tagamine kõrge energiatõhususega hoone ehitamisel. PassiveHouse OÜ, Tartu Ülikooli spin-off. Tartu Ülikooli Kirjastus, Tartu

>>> VIEWS ON THE SCALE: WHAT CAN I DO TO SAVE ENERGY?*

Participants understand how they can save energy in everyday life

Interactive game; discussion

20 Min.

paper tape

The facilitator sticks paper tape on the floor of the classroom and marks one end with 0, the middle with 50 and the other end with 100
Then the facilitator makes a statement and asks students to take the position along the tape according to what they believe or do.

Examples of statements:

- When leaving the room, I always turn off the electricity.
- I have at home a washing machine that is labelled electricity class A+++.
- I never keep the refrigerator door open too long.

Then the facilitator asks why they took a certain position. Students can express and defend their opinion. The most important part of this exercise is to discuss how everyone can save energy.

>>> WORK WITH THE PICTURE*

Participants understand the importance of saving heating energy

Discussion; narration

10 Min.

Look at the picture and discuss why the house on the right is blue, and the house on the left is yellow and red? Where does the difference come from and how was the picture taken?

Answers:
The picture was taken with a thermal camera. The image shows a greater heat loss from the house on the left side. The heat escaping from the house on the right side is less (the temperature is lower - 4 degrees) because it is better insulated (a passive house). Heating requirements of the passive house are about ten times smaller than that of a regular house.

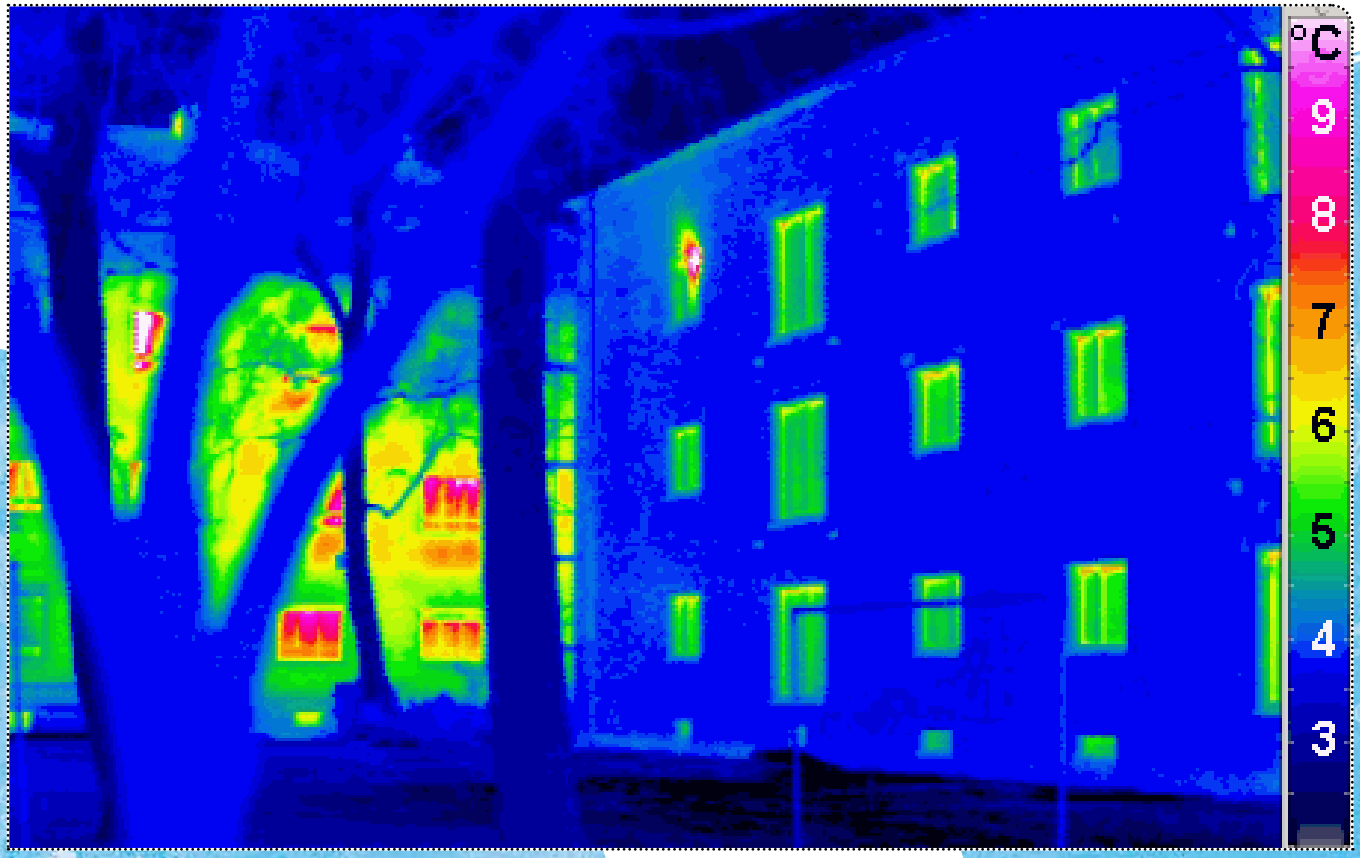


Photo source: "Passivhausthermogramgedaemmtungedaemmt" von PassivhausInstitut – Kopiert auf Commons von http://en.wikipedia.org. Originalquelle PassivhausInstitut, Deutschland – http://www.passiv.de. Lizenziert unter Creative Commons Attribution-Share Alike 3.0 via Wikimedia Commons –- http://commons.wikimedia.org/wiki/File:Passivhaus_thermogram_gedaemmt_ungedaemmt.png#mediaviewer/File:Passivhaus_thermogram_gedaemmt_ungedaemmt.png

>>> THE HEAT LOSS OF A HOUSE

Participants understand the importance of saving energy

Discussion; creative activity

15 Min.

A4 paper; coloured pencils or pastels or crayons, Internet access if possible

Draw a picture of the heat loss of a house before and after insulation: From the roof 25% (8%), from the windows 10% (5%), from the walls 35% (12%), from the ground 12% (10%).
An example can be seen: www.schoolphysics.co.uk/age11-14/glance/Heat energy/Heat_loss_from_a_house
Students present their drawing to the group

[8]Enerdata homepage. http://yearbook.enerdata.net/#energy-consumption-data.html
[9]EU New Energy Label homepage. http://www.newenergylabel.com/index.php/uk/home/

>>> DRAWING: DESIGNING AN ENERGY-EFFICIENT BUILDING**

Participants understand the importance of saving energy

Teamwork (cooperation); Discussion; creative activity

90 Min.

Large sheets of paper; coloured pencils or crayons or pastels
Internet access if possible

The class is divided into 2 groups. The facilitator gives each group a big blank paper and drawing tools to design or renovate a house.
At the beginning the groups discuss and plan how to build/ renovate a house so that it would be as energy efficient as possible. After some time, the facilitator gives each "specialist" a description of their topic. The students read the descriptions and try to improve their part according to their new knowledge. It is necessary to cooperate with other "specialists" so that the house could be good in every respect. If there is Internet access, it can be used to research further the descriptions and prices of ventilations, windows, etc.b)

>>> KOPIER-VORLAGE

DESIGNING AN ENERGY-EFFICIENT BUILDING

A. BUILDING A NEW ENERGY-EFFICIENT BUILDING

Your friend (one group member) wants to build a new house and would like to make it highly energy efficient and comfortable in every way. Design a house for your friend so that the friend would be happy and the house would be energy efficient.

Everyone in the group has a task for which he or she is responsible. When designing a house, you need to cooperate with each other so that all views are taken into account.

1. The designer (designs the position, appearance, and shape of the house)
2. Wall and roof specialist
3. Window Specialist
4. Indoor Air Specialist
5. Heating Specialist
6. The friend, the party ordering the house (appoints the location, views the layout, expresses his or her opinion)

B. RENOVATION OF EXISTING BUILDINGS TO BE ENERGY EFFICIENT

The design of new buildings is not comparable to existing buildings. In order to obtain overall energy efficiency, it is necessary to renovate old buildings. Renovating old buildings, however, is often a much greater challenge for social and economic reasons. While insulating can save energy up to 50% and living conditions can be improved, the owners must take out long term loans and carry the risk without receiving any incentive .
House renovations should begin by making an energy audit of the building. Take for example the home of one member of the group to be the renovated building and find out what condition the house is in. Everyone in the group has a task for which he or she is responsible.

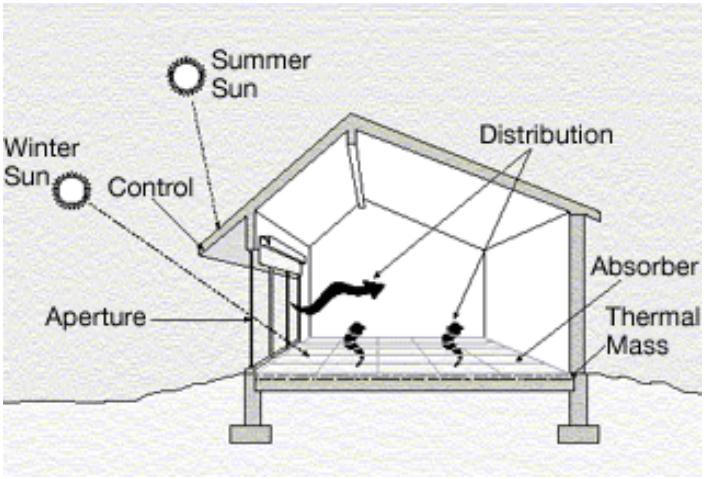
When designing a house, you need to cooperate with each other so that all the different aspects are taken into account.

1. Review energy efficiency of the building. Install thermostatic valves (each person can regulate their heat consumption) and eliminate cold bridges (in corners, in access points of windows, doors etc.)
2. External wall and roof specialist for thermal insulation
3. Window Specialist. Install energy-efficient windows, passive heating and cooling.
4. Indoor Air Specialist. Construct heat recovery ventilation, as in an air tight house without ventilation there will be a lack of fresh air (and therefore windows are opened for ventilation and that makes insulation pointless).
5. Heating specialist. Review or replace the heating system, passive heating.
6. The owner of the house / apartment / school (explains the initial situation, location of the house, etc.)

1. ENTWURF EINES ENERGIEEFFIZIENTEN GEBÄUDES

The more compact the buildings, the more energy efficient they are. Buildings with many nooks and corners leave more external surface for contact with outside air and heat transfer - in summer heat is transmitted more easily to the room and in winter cold can access the room. The smaller the external surface of the building is in relation to the volume, the better. So, for example, a one story building with many partitions is very difficult to turn into an energy-efficient house. Both the layout of the building and the objects surrounding the building are important. The surrounding houses or trees should not obscure the sun, which is needed for passive heating (the sun shines through the windows and heats the rooms). For passive heating, the longer side of the house should face south and on the south side should be large windows. It also is important for light during the day.

2. EXTERIOR WALLS



Drawing 2: Passive cooling in summer and heating in winter.
Source:“Illust passive solar d1“ by www.eere.energy.gov - www.eere.energy.gov/de/passive_solar_design.html. Licensed under Public domain via Wikimedia Commons - / commons.wikimedia.org/wiki/File:Illust_passive_solar_d1.gif#mediaviewer/File:Illust_passive_solar_d1.gif

constitute the largest part of the external surface of the building. Thus their quality and insulation affect the heating and cooling needs of the building. In addition to good insulation of external walls, it is also important to have high-quality connection points to prevent the formation of cold bridges (places where heat is transmitted well forward).Roof insulation is also very important, as heat escapes from the building through a large portion of the roof (hot air rises upwards). The roof is a good location for solar collectors, but it should be designed with a slope in the direction of the sun.

3. FENSTER

are a possibility for both passive solar heating and lighting. However, at the same time, a lot of energy escapes through windows. Several times more heat per area unit is lost through windows than through walls. However, in warmer areas and during summer, very large windows may lead to excessive heat caused by sunshine, which is why it takes more energy to cool. Therefore a balance has to be found, taking into account both size and position of windows. Considering the entire window surface of a building, it is recommended to place at least 60% on the south facing side and not more than 10% of the windows on the north facing side[12]. Passive cooling is important during the warm season. Using air conditioning requires unnecessary energy. In order to reduce energy consumption, it is a good idea to put sun protection in front of windows to prevent direct radiation reaching the room. Sun protection can be achieved by movable shade contraptions or by the roof extending enough to prevent sun from streaming through the windows in summer. The roof must be designed in such a way that it would not prevent the winter sun from streaming in at a time when thermal energy is needed.

[12]Mauring, T., Hallik, J., Siiner, A., Valge, M. 2009. Passivmajatehnoloogia. Kvaliteedi tagamine kõrge energiatõhususega hoone ehitamisel. PassiveHouse OÜ, Tartu Ülikooli spin-off. Tartu Ülikooli Kirjastus, Tartu.

4. INDOOR AIR FRESH AIR IS VITAL

- if the house is insulated well and almost airtight , built-in ventilation is needed. Old and poorly insulated buildings have natural ventilation, which means the natural air exchanges through windows, non-tight places or air openings. However, it is not too smart to let cold air in and warm air out for the sake of ventilation. A more effective solution is heat recovery ventilation. The air leaving the room carries its heat to the outside cold air into a heat exchanger. There are heat exchangers with up to 90% heat recovery equipment and it, therefore, requires only very little post-heating for the room temperature to be constant. Fresh air injection could take place in the sleeping and living area and extraction from the wet rooms and the kitchen. In order for ventilation to be fully effective, the piping could be short and with a large diameter. The optimal solution is to locate cold pipes outside and warm ones inside because it reduces heat losses. The heat exchanger located between these pipes could thus be located close to the heat proof boundaries[13].

[13]Mauring, T., Hallik, J., Siiner, A., Valge, M. 2009. Passivmajatehnoloogia. Kvaliteedi tagamine kõrge energiatõhususega hoone ehitamisel. PassiveHouse OÜ, Tartu Ülikooli spin-off. Tartu Ülikooli Kirjastus, Tartu.

better. So, for example, a one story building with many par-

5. PASSIVE (DUE TO SOLAR RADIATION) HEATING

is, in case of well-insulated buildings, a very important source of energy. This may reduce the amount of required heat by 25-75%[14]. Also, materials used in construction are important - the inner wall and the floor should be made of materials that can store heat well such as quarry stone, clay, etc. During the day solar energy is stored and radiates from there as heat back to the room over a longer period. Furthermore, in a low-energy house a significant amount of heat that is needed is given by the heat of human bodies and the working of electric appliances.

The heating needs of energy efficient buildings are small, but in winter there is still a need for a heating device. This could be, for example, an oven, electric heating, geothermal heat pumps, gas heating, air source heat pump (air-to-air, air-to-water), local solid fuel boiler (wood, pellets, peat briquettes, charcoal briquettes, etc.) or district heating.

[14]Whole Building Design Guide homepage. http://www.wbdg.org/resources/psheating.php

4. RENEWABLE ENERGY

An alternative to energy derived from fossil fuels is renewable energy produced from renewable sources such as sun, wind, water and biomass. The development of renewable energy has been rapid in recent years. The International Energy Agency (IEA) predicts in its journal World Outlook 2013 that by 2035, renewable energy production will double. However, at the same time the primary energy need of the world is growing by 43%. Looking at the big picture does not change the current proportions of energy production very much. The share of fossil fuels is now the same as 25 years ago (82%) and by 2035, the IEA predicts that the share will be 75%. The IEA also sees continued growth in greenhouse gas production by 20% in energy production. This means in the long term a 3.6°C rise in temperature exceeds the agreed 2°C by far, which is the limit for preventing dangerous consequences[15]. So, given the current trends, there are big challenges for the future; the successful development of renewable energy is important and necessary. More powerful batteries for storage of uneven flow of wind and solar energy are currently developed, as well as other options for storage, such as pump-hydro power plants. More information for storage can be found on the website of the World Watch Institute[16].

Even ordinary consumers can take steps to support renewable energy. In the European Union's open electricity market, each person can choose what kind of electricity they wish to purchase. As proof of renewable energy, certificates of origin are issued that show exactly where, how much and what kind of electricity is produced. Thus, for example, electricity consumers can choose a renewable energy package or purchase green energy recognized by the EKOenergia label (www.ekoenergy.org).

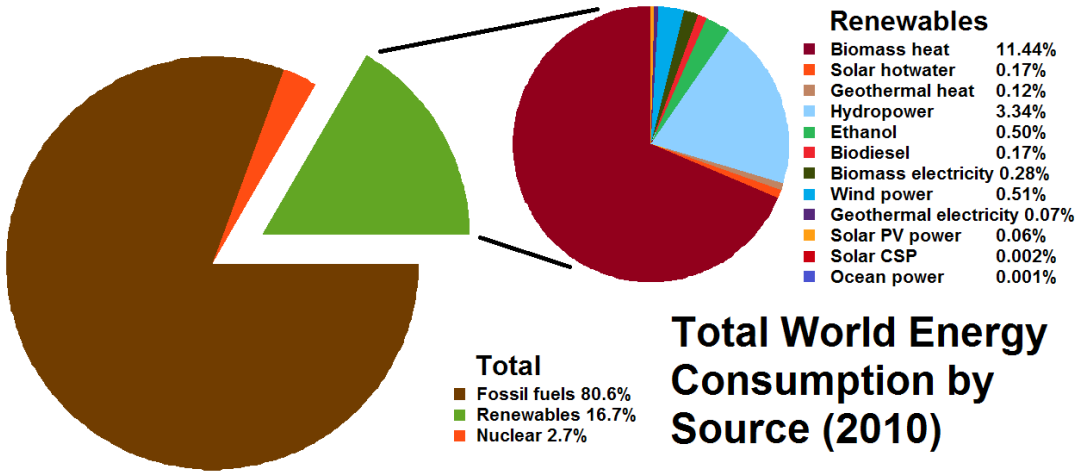
Electricity Pie Chart

In 2012, renewable energy consumption increased by 15.2% and renewable electricity accounted for 4.7% of global electricity generation[17]. Europe produced in 2012 24% of electricity from renewable sources.

How big is the power consumption? What are the main sources of energy for electricity and for heating? How big is the share of renewable energy and which types are most commonly used?

Draw a pie chart on the board and try with the students to put into place the size of the different energies sources used. Separate electricity and energy use diagrams could be made. Information can be found, e.g., in Enerdata, Global Energy Statistical Yearbook[18] and databases of national network enterprises.

When looking at and comparing statistics, it is worth to note the difference between energy production and electricity production. Also, whether it is about production or consumption, since these figures are different (due to mutual



Drawing 3: The share of renewable energy in final energy consumption in the world in 2010[19]

[15]Thomas K. Gorse. IEA World Outlook: Six Key Trends Shaping the Energy Future. National Geographic 12.11.2013. news.nationalgeographic.com/news/energy/2013/11/131112-iea-world-outlook-2013-six-key-trends/

[16] Gonzales, M. Storage Solutions Allow for Renewable Energy on Demand. Worldwatch Institute. 19.12.2013. http://www.worldwatch.org/node/14077

[17]BP Statistical Review of World Energy. 2013. http://www.bp.com/en/global/corporate/about-bp/energy-economics/statistical-review-of-world-energy-2013/review-by-energy-type/renewable-energy/renewable-power-.html

[18]Enerdata. Global Energy Statistical Yearbook. http://yearbook.enerdata.net

[19]„Total World Energy Consumption by Source 2010" by Delphi234 - Own work. Licensed under Creative Commons Zero, Public Domain Dedication via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Total_World_Energy_Consumption_by_Source_2010.png#mediaviewer/File:Total_World_Energy_Consumption_by_Source_2010.png

>>> WHAT KIND OF ELECTRICITY DO YOU CONSUME?*

Participants assess their knowledge of renewable energy.

Discussion; presentation

10 +10 Min.

-

The facilitator asks students to get into pairs. The students tell each other what kind of energy they use in their homes. Supporting questions: What kind of electricity is used in your home? Discover the options to switch to green electricity. What contracts do your electricity suppliers offer? Do they offer EKOenergy or some other eco-label? What kind of renewable energy is it? Is it more expensive or not (often the price difference is marginal). Find out how much electricity you consume in a month and discuss how much difference it makes to use green electricity instead of fossil fuels.

After the discussion the students tell the group what the partner has told them.

>>> THE COMIC - ACTIVE YOUNG PEOPLE CAN CHANGE THE WORLD*

Participants learn that young active people can do something for renewable energy, and that they could be these people.

discussion

60 Min.

EKOenergy comic in paper, e-reader or computer

The facilitator hands out the EKOenergy comic, which is available in their own language: http://www.ekoenergy.org/extras/ekoenergy-comic/. Students read the comic and discuss later: Can we do something similar to Sofia to support renewable energy? How did she become successful? Is there a plan to build a new fossil energy or renewable energy power plant in our area? In the end of the comic there are suggestions for everyday life, which the facilitator could also use to get ideas for the task 4.1.

5. WIND ENERGY

Wind power has a great perspective, and its growth has been rapid. As of the year 2012, wind power capacity worldwide totalled 283 GW. The largest producers were China, the U.S., Germany, Spain and India[20]. By comparison, in 1996 worldwide production capacity was only 6.1 GW.

In the recent past there has been an increase in planning offshore wind farms, e.g., in 2013 Europe completed a third more wind turbines at sea than during the preceding year[21]. Europe now holds a leading position in the development of wind farms and according to the data of the European Energy Agency, the European offshore wind energy potential is seven times higher than the European energy requirement[22]. For the most recent statistics on Europe check the European Wind Energy Association EWEA homepage[23].

How much of the total power production is generated by wind power, how much by renewable energy? Have you seen wind farms in your neighbourhood?

5.2. How can wind generate power?

Wind turbines convert moving air energy into electricity. It has rotating blades whose movements cause rotation of a slowly moving shaft. This, in turn, is connected to a fast-moving shaft by means of a toothed wheel, which causes the generator to produce electrical power. Finally, the electricity goes to a transformer, where the voltage is converted for use on the power grid

Types of wind turbines

Wind turbines can be divided roughly into two - vertical and horizontal wind turbines. Horizontal axis wind turbines are the most common ones used in wind farms. They produce electricity most efficiently when the wind is blowing directly at them. Thus many wind turbines have a built-in motor that rotates the turbine head in the right direction. Small windmills can have a tail instead of an electric motor (like the weather vane), which helps to maintain the correct position in case of a change in wind direction.
Vertical axes wind turbines are not so widespread. These are used to some extent for small productions, but they are less able to take advantage of large wind velocities.

Small manufacturing and energy cooperatives

Small windmills are a good option for partially meeting the energy needs of a household with renewable energy. The windmill alone usually does not provide the necessary energy, but in conjunction with other renewable energy solutions, it is a useful addition. When erecting a wind turbine, be sure to choose a suitable location, otherwise it may be a big disappointment. There is no point in installing a generator just anywhere. In cities, for example, there are too many objects around that give rise to turbulence and the wind turbine cannot be used to its full potential.

People interested in wind energy do not necessarily have to put up a wind turbine on their roof. In some places, it is possible to buy a share in a wind turbine or a wind farm. For example, in Denmark it has long been popular to create energy cooperatives where people invest jointly in wind farms. The surrounding residents are wind farm owners and generate electricity for themselves and sell it on the market. It has contributed enormously to the development of wind energy and also increased its social approval. By the year 2001, in Denmark, 100,000 families had invested in wind energy and by that time cooperatives had built 86% of all wind generators in Denmark[24].

[20]REN 21. Renewables 2013. Global Status Report. http://www.ren21.net/portals/0/documents/resources/gsr/2013/gsr2013_lowres.pdf

[21]European Wind Energy Association. The European offshore wind industry - key trends and statistics 2013 www.ewea.org/fileadmin/files/library/publications/statistics/European_offshore_statistics_2013.pdf

[22]EWEA homepage. Offshore wind. http://www.ewea.org/policy-issues/offshore/

[23]EWEA homepage. Statistics. http://www.ewea.org/statistics/

[24]IRENA. Wind Report Denmark 2011. IRENA-GWEC: 30 YEARS OF POLICIES FOR WIND ENERGY www.irena.org/DocumentDownloads/Publications/IRENA_GWEC_WindReport_Denmark.pdf

>>> WIND TURBINE OPERATION PRINCIPLE**

Participants know more about wind energy.

individual work, discussion

35 Min.

Internet access, text with blanks (copy template), pencils

Check with students the EWEA's website (in English with interactive testing), how a wind generator works: www.ewea.org/wind-energy-basics/how-a-wind-turbine-works/
Discuss with them why wind energy is good, in which countries wind generators can be used, and what problems they can cause.
After the discussion, ask students to fill in the blanks in the following text:

Wind energy gaps answers

1. on the structure and location of the wind turbine
2. more
3. Four times more
4. 250 kW wind turbines in offshore wind farms, 2.5 MW
5. 4-25 m/s, would harm the wind turbine construction
6. offshore and higher
7. turbulence (whirlwind)
8. lower
9. on land, coastal waters or offshore.
10. cheaper, smaller, the location
11. power
12. near the building, on the roof of the building

>>> COPY TEMPLATE

WIND TURBINE OPERATION PRINCIPLE

Fill in the gaps:

1. The amount of electricity produced depends on _____ and _____

2. The larger the blade, the_____ electricity the turbine produces

3. Twice the size of the blade may give up to _____ times more power)

4. The power of wind turbines begins at_____ the largest are_____ wind turbines with a capacity of up to 7 MW, the average onshore wind turbine is about_____

5. Medium-sized wind turbines operate when the wind speed is _____ - _____ m / s. In case of lower wind speeds the yield would be too small, with a higher wind speed, however _____

6. There is more wind and it is more consistent _____ and _____

7. It would be important that the wind turbine would be situated in an open area without higher objects, because otherwise there will be _____ _____ which greatly reduces the productivity.

8. Productivity is_____ in the mountains because the air pressure is lower and the air is "lighter".

9. Wind farms are built _____ , or _____ .

10. On the land and coast, wind farms are _____ cheaper/more expensive_____ to build, but their production capacities are_____smaller/bigger _____ and often it is difficult to find a good _____ that would be open to the winds, in a comfortable distance from human settlements and from the important nature conservation sites.

11. The construction of offshore wind farms is much _____ cheaper/more expensive _____ _____ , but also the _____ wind turbines are greater.

12. For one's own use small wind turbines can also be_____ , etc.

The assisting words that go into the gaps (an easier version):

to the proximity of the house/ on the land/ location/ in the sea/ wind turbine structure/ building roof/ lower/ from the location/ 4/ more/ 250 kW/ offshore wind farms/ 4/ offshore/ 25/ damaging the structure/ higher/ turbulence (whirlwind)/ more/ 2,5 MW/ coastal seas/

>>> NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION- "STEP INTO THE SHOES" AND DECIDE */**

Students know about social problems/ behaviour concerning the construction of wind farms

Individual work; Reading text; discussion

90 Min.

Internet access; text; worksheets with tables; worksheets with correct answers; pencils

The facilitator can choose whether to use the entire exercise which is suitable for advanced students or only some parts.

Step 1

The facilitator gives the following task: try to imagine that company X wants to construct a wind generator close to your home. Do you like it? Why? Or you don't like it? Why not? How do you feel about it?

Step 2

The main argument against wind power seems to be the NIMBY (not in my backyard) syndrome. See together with students Joe Heller's comic energy and wind NIMBY syndrome: http://www.treehugger.com/clean-technology/arguments-against-nuclear-oil-coal-and-wind-pic.html and discuss how seriously comparable the various energy production problems are compared to wind energy.

Step 3

The students read the text on nature conservation below and answer the following questions:

- What is the main concern of nature conservationists regarding wind farms?
- What is people's main concern regarding wind farms?
- How are deaths of birds and bats caused by wind farms investigated?
- If birds/bats do not get killed flying straight into the turbine then what else can be fatal for them?
- Why do wind farms and birds have similar location preferences?
- What mitigation measures are used to protect birds/bats?
- Why are offshore wind parks favourable for some species?
- Try to find bird conservation areas located in your country. Have wind farms been set up on these sites? What happened?
- How long is the lifespan of a wind turbine and how soon will it reproduce the amount of energy spent on its construction ?

Step 4

To summarise the topic, the facilitator asks students to fill in the summary table, then gives them the table with the correct answers so they can compare this with their own answers. Facilitators should be available to assist.

NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION

As we want to get good and sustainable energy solutions using renewable energy and not just a better alternative to fossil fuels, we must, take into account all the bottlenecks. Looking at the development of wind farms, the key word is location. It must be a suitable distance from human settlements, as well as from key nature conservation locations and at the same time ensure good wind conditions. This restricts the selection, but with good planning it should not be impossible. Currently, there is an increase in planned offshore wind farms. This eliminates the "backyard concern" and the consideration is mainly the impact on the natural environment. Below we will address nature and environmental protection, as in social and economic issues there are so many different opinions, research and insights that could not be summarized here. Of course, the social aspects of each wind farm planning must be taken into account. This is usually done in the framework of the environmental impact assessment.

Much has been said about the perishing of birds because of wind turbines. In addition, the same fate awaits also smaller and more hidden flyers - bats. Perishing of birds and bats is very difficult to investigate accurately because on land, they become prey for carrion-eaters and the research performed is resource-intensive and requires large areas of continuous interactions. At sea, try as you may, it is not possible to count the number of birds killed and the effects must be assessed indirectly. It can, however, be estimated that at the moment the number of birds and bats killed due to wind turbines is lower than by other human causes such as the death of birds caused by glass surfaces or electrical power lines[25]. In any case, it is important to find locations for wind farms that are not in massive gathering places of birds and bats.

Wind farms, which are located in the migratory routes or habitats of birds and bats, may also cause indirect harm. Even when birds and bats do not set their lives at risk flying through the wind farm, circling around these requires extra energy, which, along with other factors, can be fatal. The deaths of bats can be caused by barotraumas - due to barometric pressure change, caused by the rapid rotation of the wind turbine blades, the lungs of the bats get damaged, and there is internal bleeding[26].

Unfortunately, the situation is such that often the same locations are suitable for birds and for wind turbines. In shallow areas there are better feeding conditions for birds and costs for installing wind turbines are lower. In coastal areas there are nesting sites for many birds and more favourable wind conditions. Wind farms built in bird habitats drives birds out of the area (based on studies, several species keep 1-2 km away). One wind farm is not a big problem for the bird population, but if there are many, the habitats of sensitive species will be diminished more and more.

Mitigation measures

A number of ways have been explored to avoid collisions of birds and wind turbines.. For example, the risk zone is monitored by radars, and if birds are found nearby, the system automatically switches on a light or sound signal chasing birds away or stopping turbines entirely. It has also been tried to make wind turbines more visible, painting wind rotor blades to have more contrast or UV light and colours are used, as the birds have in this spectrum quite good vision. During night time, when many birds and bats migrate, they may, due to poor visibility conditions, fly towards the light of the wind farms and get trapped there. To avoid this, some farms turn off the lights at night during migration periods in spring and fall or use them only as needed (for approaching ships and planes). It is also an opportunity to change the lighting so that it would not attract the birds that much[27].

The impact of offshore wind farms on marine life

The impact of offshore wind farms on marine life has been studied very little and research is in many cases quite complex (e.g., how to determine how much the construction or operating noise affects fish life). Wind farms chase away several species, but new habitats emerge, such as the base of the platform for wind turbines generates an artificial riff, which various aquatic organisms attach to. This in turn attracts many small fish, who seek shelter and food there[28].

Wind turbine environmental impacts throughout the lifecycle

Of course, the environmental impact associated with the construction of a wind turbine as well as the impact on the entire life cycle (from acquisition of the building material up to the end of a lifetime of the turbine) should be noted. Consideration should be given to the production of several metals, but with good planning much can be recycled after the end of the lifetime of the wind turbine (about 20 years). The wind generator makes up rather quickly for the amount of energy that it takes to manufacture. For example, a 3MW offshore wind turbine life cycle analysis has found that the wind turbine offsets within about six months the amount of energy that has been spent for its construction[28].

[25]American Bird Conservancy. Birds and Collisions. http://www.abcbirds.org/abcprograms/policy/collisions/index.html

[26]Handwerk, B. Wind Turbines Give Bats the "Bends," Study Finds. National Geographic. 25.08.2008. news.nationalgeographic.com/news/2008/08/080825-bat-bends.html

[27]Robin Brabanti esitlus. Offshore wind farms in the Belgian part of the North Sea: understanding environmental impacts. http://www.tuuleenergia.ee/wp-content/uploads/Robin-Brabant.pdf

[28]Renewable Energy World homepage. Assessing the Life Cycle of Wind Turbine Production. 18.04.2005.

NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION

The wind farm type	Land/Coastal	Offshore
The financial cost		
Nature Conservation		
Power		

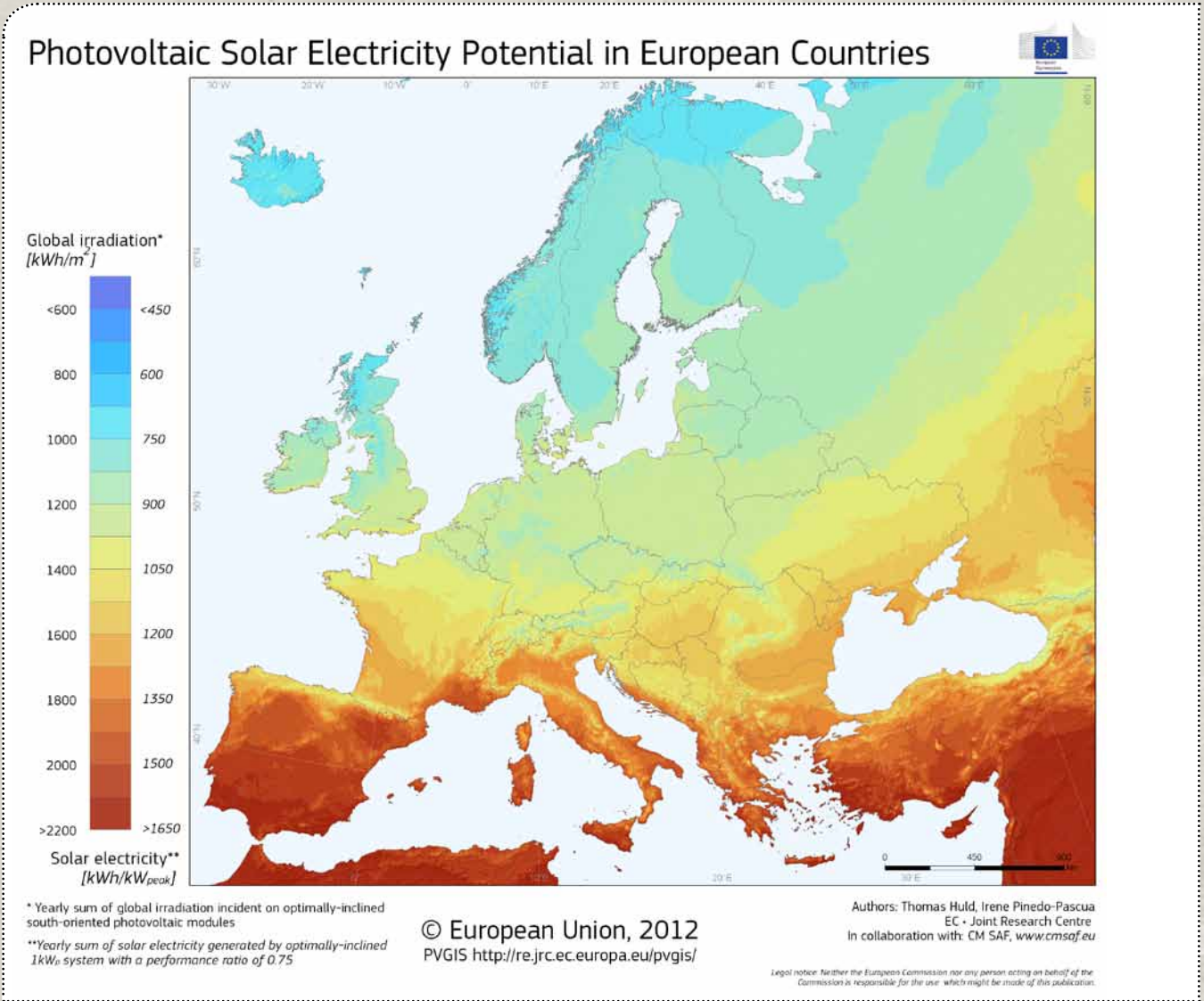
Solutions

The wind farm type	Land/Coastal	Offshore
The financial cost	Cheaper, closer to power lines	More expensive, power lines farther, deeper water that is more costly to build
Nature Conservation	Conflicts with birds for habitats and movement tracks, on the movement tracks of bats	Conflicts with bats and birds for the movement tracks, repels from some of the marine species but are also habitats for some species.
Power	On average, 2.5 MW, the wind quieter and less consistent	Up to 7 MW, the wind stronger and more consistent

6. SOLAR ENERGY

Solar energy can be harnessed with various technologies and can be used for heating or cooling buildings, for generating electricity and hot water. Here, we will discuss technologies using solar energy for hot water and electricity. It pays to make a difference: solar panels or PV panels (photovoltaic panels) are devices that convert sunlight directly into electricity; solar collectors use the sun to produce hot water. This, in turn, can be used for heating purposes or for the production of electricity (for this the temperature of the water must be a very high). Solar power is unevenly distributed across the globe. One might expect that more attention is paid to the development of solar energy in the south. However, the maximum power output of solar panels is in Germany, where the amount of solar radiation per year is, at best, mediocre (see Figure). In 2012, the largest number of solar panels was installed in Europe. In comparison with other methods of energy production, solar panels constituted 37% of all new capacity.. In Germany, the capacity of solar panels installed exceeded the capacity of wind turbines. Prices of solar panels have come down in recent years with remarkable speed. During 2012, for example, prices have decreased by 30%[29]. Of course, such a big decrease in price cannot continue indefinitely. But for now the price for solar panels is sufficiently favourable to make it worthwhile even in northern Europe to invest in the roof on one's home.

[29] www.pv-magazine.com/investors/module-price-index/



Drawing 4: Solar energy potential in Europe[30]

[30]Šúri M., Huld T.A., Dunlop E.D. Ossenbrink H.A., 2007. Potential of solar electricity generation in the European Union member states and candidate countries. Solar Energy, 81, 1295–1305, http://re.jrc.ec.europa.eu/pvgis/. Huld T., Müller R., Gambardella A., 2012. A new solar radiation database for estimating PV performance in Europe and Africa. Solar Energy, 86, 1803-1815. http://re.jrc.ec.europa.eu/pvgis/countries/countries-europe.htm

>>> FILLING IN A PIE CHART*

Students know about solar electricity potential.

individual work

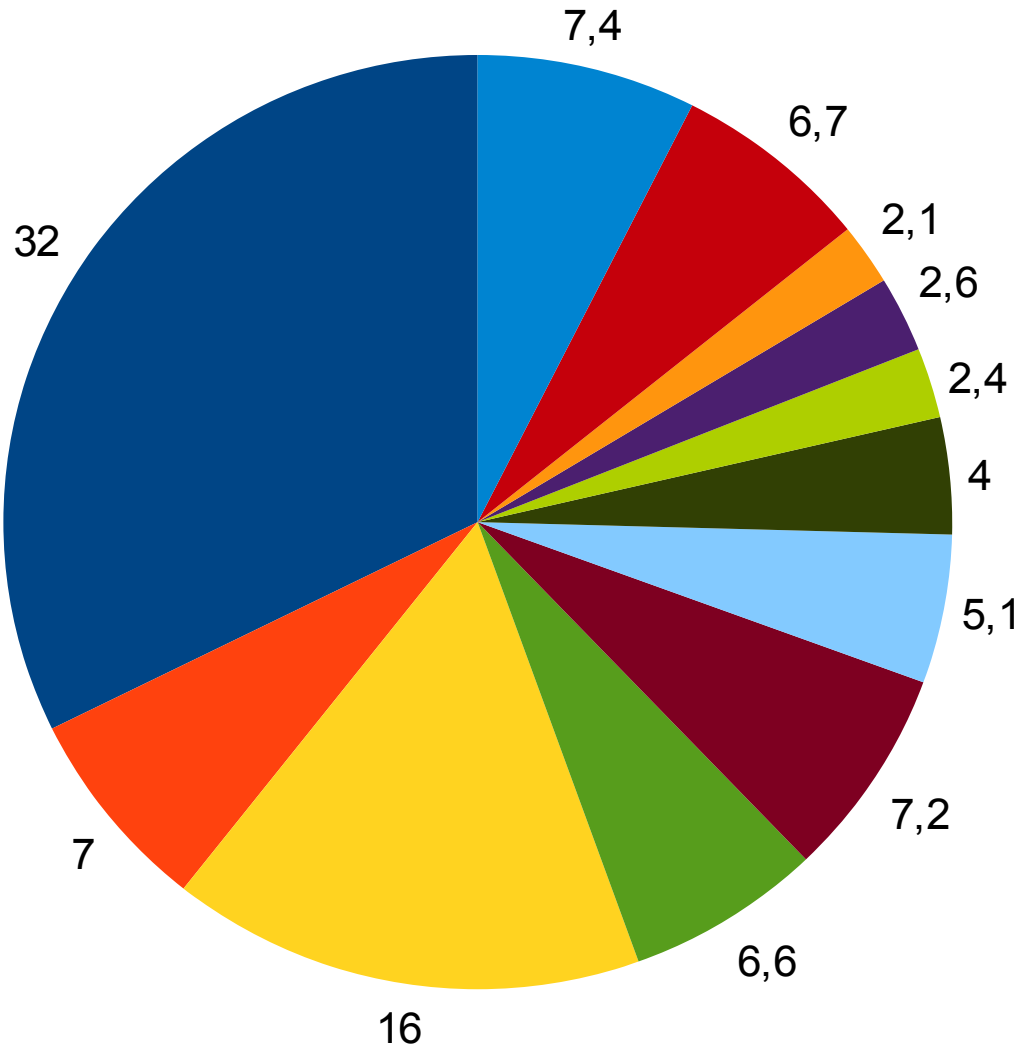
15 Min.

Give students an empty pie chart (see below) on the use of solar panels to produce electricity in different countries and the names of the countries. Students must write the name of the right country in the right place.
Countries: Belgium, Germany, Czech Republic, Italy, China, USA, Spain, Australia, France, Japan, the rest of the EU, the rest of the world.

What was the world's total production in 2012? 5 GW, 100 GW or 5,000 GW? (answer: 100 GW)

Answers

Germany 32%, China 7%, Italy 16%, Japan 6,6%, USA 7,2%, Spain 5,1%, France 4%, Australia 2,4%, Belgium 2,6%, Czech Republic 2,1 %, rest of the EU 6,7%, rest of the world EL 7,4%



Drawing 5: Solar panels capacity in the year 2012, the ten largest producers in percentages.
Details: Renewables 2013.Global Status Report

>>> SOLAR POWER IN DEVELOPING COUNTRIES
DISCUSSION, WATCHING A MOVIE*

discussion, watching a movie

90 Min.

internet access

Participants know about the situation in the Global South concerning solar power. Participants develop an insight into the social problems in the global South.

The facilitator and students watch a movie. Link to the movie: www.youtube.com/watch?v=ON_NQ1HnRYs&feature=youtu.be

Step 1

Discuss why there are not many solar energy installations in countries which have a lot of sun, for instance in African countries? Southern countries are poorer and do not have the capacity to invest in big solar parks. However, small-scale solar energy production is getting popular. In many African villages, for example, solar power is the only option to get electricity.

Step 2

Watch the movie "Solar mamas" by Mona Eldaief and Jehane Noujaim, which talks about women gaining equality in developing countries when they are given the opportunity to learn how to build solar panels. This is a touching story which helps students understand how difficult (but still possible) it is to strive for equality and sustainable solutions in developing countries.

Step 3

Have a discussion about the film. Some example questions: Why did Rafea have difficulties going to barefoot college? What were the main obstacles for women in barefoot college to study engineering? What happened when Rafea came back to start a solar engineering business? Do you think the same opportunity should have been offered to men as well?

>>> HOW DO SOLAR TECHNOLOGIES WORK?
CREATING A FLIPCHART POSTER**

Participants know about solar technologies.

individual work; reading text; discussion; presentation ("exhibition")

90 Min.

Internet access; flipcharts; old magazines; colour pencils; pastels; crayons; glue; scissors; text hand-outs

Solar power plants produce electricity most commonly in two ways:

- sunlight is converted directly into electricity using solar panels
- thermal radiation is concentrated with the help of mirrors into collectors reaching a very high temperature and water vapour which produces electricity
- hot water for household use is produced using solar collectors

The facilitator asks students to look at the pictures, read the descriptive text below and find out which solar solutions are in the picture.

Answers:

Picture 1. One of the largest solar panel plants in North America, in the Mojave Desert, over 57 hectares of land, 14 MW power[57].

Picture 2. Solar system for water heating on the roof of a house in Jerusalem [58]

Picture 3. Solar-thermal power plant near Seville, Spain. „Planta Solar 20 ,tower capacity is 20 MW [59].

Then every student creates a flipchart poster with the solution she/he likes and wants to share with others. Students can use different styles: collage; drawing etc. If the project lasts more than one day and the group uses the same room, the posters can stay on the floor.

[57] „Giant photovoltaic array" by U.S. Air Force photo/Airman 1st Class Nadine Y. Barclay - NELLIS AIR FORCE BASE website - Solar panels connect to base electric gridorignial image. Licensed under Public domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Giant_photovoltaic_array.jpg#mediaviewer/File:Giant_photovoltaic_array.jpg

[58] „Solarboiler" by Gilabrand at en.wikipedia - Transferred from en.wikipedia. Licensed under Creative Commons Attribution 2.5 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Solarboiler.jpg#mediaviewer/File:Solarboiler.jpg

[59] „Gemasolar" by Torresol Energy - abc123. Licensed under Free Art License via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Gemasolar.jpg#mediaviewer/File:Gemasolar.jpg

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HOW DO SOLAR TECHNOLOGIES WORK?

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HOW DO SOLAR TECHNOLOGIES WORK?

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HOW DO SOLAR TECHNOLOGIES WORK?

1. SOLAR PANELS

For manufacturing solar panels a variety of different materials are used. The most widely used are single crystal silicon panels and polycrystalline silicon panels, which make up 93% of the panels sold worldwide[31]. Other methods use thin-film panels, hybrid panels, etc., and current developments take new directions such as the use of nanotechnology and organic solar cells.

How can sunlight become electricity? Solar panels are made of semi conductive materials. When light hits the panel the energy moves from the sun to the semiconductor and sets the electrons free. Electrons have been made to move by way of an electric field into a certain direction. This movement of electrons is the current, and when the metal contacts are placed up and down on the ends, the electrical current can be lead to the inverter, where the created direct current is converted into alternating current which can be exploited in the household[32].

Did you know that the first solar panel was built as early as 1883, but its efficacy was only 1%? In the middle of the 20th century, the development of solar panels began more actively, and they were mainly used to operate satellites. Later, paradoxically, it was used to cover energy needs of offshore oil drills. Hence fossil energy was obtained using solar energy. Major oil producers such as Exxon, ARCO, Shell and Amoco all began manufacturing their solar panels and these were used in this field for several decades[33].

Why are solar panels usually a bluish colour? The colour blue receives the most solar radiation and reflects it back the least[34] Black coloured solar panels heat up excessively and therefore lose their effectiveness[35].

Check out the video on the operation principles of a solar panel operation: www.youtube.com/watch?v=1gta2ICarDw

[31]The Eco Experts. Solar PV Price Comparison http://www.theecoexperts.co.uk/solar-pv-price-comparison
[31]science.howstuffworks.com/environmental/energy/solar-cell1.htm
[33] Wikipedia: Solar Cell http://en.wikipedia.org/wiki/Solar_cell
[34] The Eco Experts. Solar PV Price Comparison http://www.theecoexperts.co.uk/solar-pv-price-comparison
[35]C Changes homepage. Which Type of Solar Panel is Best for You? http://www.c-changes.com/types-of-solar-panel

2. SOLAR-THERMAL POWER PLANTS

These plants concentrate solar radiation by means of mirrors or lenses, and a very high temperature is achieved which is necessary for driving an energy generating steam turbine. The positive side of such plants as compared to solar panels is that they can ensure a constant flow of electricity even when there is no sun. In this case, the stored thermal energy is used first and then if necessary, the biomass based boiler, for example, is used which turns on the steam turbine.

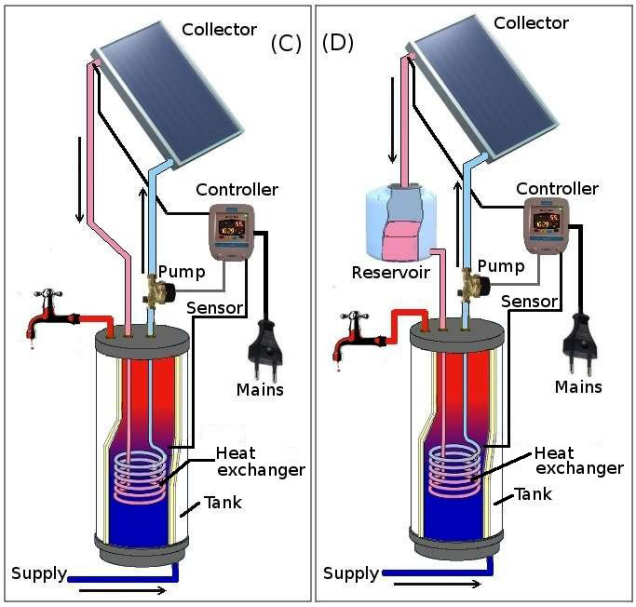
There are a number of technologies for obtaining electricity using solar heat. One common example is a solar thermal power plant. In such plants, there are hundreds and even thousands of large mirrors that are mounted around the tower. The mirrors are slightly curved to collect and reflect radiation better. An automatic system calculates the best position for each one and using the built in motor they move towards the sun. The system has to be very precise for the solar radiation to be reflected exactly to the top of the tower, where the heat collector is located. Concentration of radiation raises the temperature to 1000°C or more. Hot air or molten salt transports the heat from the collector to the steam generator, which produces very high temperature water steam, which in turn turns on the steam turbine to produce electricity[36].

It makes sense to build solar-thermal power plants in areas with plenty of sunshine. They can only make use of direct radiation (in comparison - solar panels take advantage of diffuse radiation, i.e., electricity can also be obtained on a cloudy day). They require a large open area and therefore these developments are very promising developments particularly in deserts . In theory, it is possible to secure the entire world's current electricity demand by covering 1% of the Sahara desert with such solar plants[38]

Watch a video on the solar thermal power plant operation principle:www.planetforward.org/idea/concentrated-solar-thermal-plant-with-energy-storage-how-it-works

[36]www.volker-quaschning.de/articles/fundamentals2/index_e.php
[38]DLR homepage. http://www.dlr.de/sf/en/Portaldata/73/Resources/dokumente/flyer_allgemein/DLR_Institute_of_Solar_Research.pdf

3. SOLAR COLLECTOR FOR RECEIVING HOT WATER



Drawing 6: Solar collector for receiving hot water[42]
[42]IndirectSystemSchematics2" by Euro-Flachstecker_2.jpg: Somnus-Derivative work: Willemferguson (talk) - Euro-Flachstecker_2.jpg. Licensed under Public domain via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:IndirectSystemSchematics2.jpg#mediaviewer/File:IndirectSystemSchematics2.jpg

At lower temperatures, it is possible to make use of solar heat energy, for example, for ventilation, hot water and cooking. In northern Europe, it is more efficient to use solar energy in households for getting hot water rather than electricity. In a well-insulated house, a bigger part of the energy goes to heat water; it will take 50-80% of the total heat requirement[39], so it is an important saving to use solar energy for that. The solar collector should face south, and the angle depends on the latitude of the location and the purpose. In Nordic countries, for example, capturing the winter sun is best at 55°, capturing the summer sun at 35°[40].
There are two types of hot water collectors: vacuum collectors and flat-plate collectors. The price per square meter for a flat plate collector is lower but the panels with vacuum tubes are 30% more powerful than the flat plate ones (making better use of diffuse radiation) and they work well also in minus 30 degrees (well suited for cold climates).
The most common hot water collector for a single-family house consists of a solar collector and water storage; in addition, a pump is necessary that would move around the liquid in the pipes (see illustration). Solar energy is stored in the collector and moves with the heat-bearing fluid (such as a water-glycol mixture, which does not freeze in winter)[41] to the tank where the liquid inside of the tube transfers the heat to the water in the tank (hot water rises upwards, and therefore is guaranteed the continuous transfer of heat from below). If the liquid in the tubes has gradually transferred its heat, it moves back towards the solar collector to heat up again there. Warm water from the tank can, however, move to the pipes and to the boiler for longer term storing.
See also how the collector works:
youtube.com/watch?v=-Lovrsjeh9g

[39]Badescu,V., Staicovici, M.D. 2006. Renewable energy for passive house heating: Model of the active solar heating system. Energy and Buildings Vol. 38, No. 2, pp 129-141.
[40]Mauring, T., Hallik, J., Siiner, A., Valge, M. 2009. Passivmajatehnoloogia. Kvaliteedi tagamine kõrge energiatõhususega hoone ehitamisel. PassiveHouse OÜ, Tartu Ülikooli spin-off. Tartu Ülikooli Kirjastus, Tartu.
[41]Taruste, T. 2011. Päike annab sooja vee, elektrit veel mitte. Äripäev, 27.04.2011. http://www.ap3.ee/?PublicationId=31503ED6-39D4-4163-9D98-74AA1E3959CE&code=31599

>>> NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION

THINK, PAIR AND SHARE*

Individual work; group work; decision making

90 Min.

Flipcharts; note papers; pens.

Participants understand the impact of solar panels on nature and people.

This activity prompts student to reflect on a topic and then to share their thoughts with others.
Students work in pairs. The facilitator presents the text below and compares the environmental impact of solar panels with:
1) the environmental impact of fossil fuels (chapter 1.2) and
2) the environmental impact of wind farms (chapter 5.3).

Using note paper, students spend a period of time gathering their personal thoughts on the question at hand and then discuss their ideas with a partner. After consolidating their ideas they form groups of four and discuss and again consolidate their views in the group.
The groups present the group work results and the whole group discuss the topic. The agreed statements will be written on a flipchart. The facilitator guides this process.

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NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION

Nature Conservation

Solar panels on the roof of buildings are not a special danger to the natural environment, but large solar power stations occupy a considerable area of land. One of the largest solar power-generating stations, Agua Caliente Solar Project covers an area of 1,000 hectares, or nearly 10km^2 [43]. While the land under a wind farm can be used for agriculture, for example, solar panels will cover the ground closely, and this area cannot be used for other purposes. Thus, the location should be one which is already in use by humans, or where there are no significant species and communities from a nature conservation point of view.

Environmental impacts throughout the lifecycle

The most significant environmental impact is caused by the solar panel production process, which requires considerable amounts of energy. However, depending on the type of panels, the energy spent for production will pay off in 1-4 years[44]. For manufacturing panels, a number of harmful compounds and metals are used - e.g., lead in case of silicon panels, and cadmium telluride in case of thin-film panels, which are carcinogenic, cause mutations in genes and affect DNA. In a relatively large number of thin-film panels indium tin oxide is used, which is also dangerous. With correct use, handling and recovery it is possible, however, to avoid potential hazards[45].

Companies manufacturing solar panels are thinking about recovery, though larger quantities have not yet outlived their useful life, and waste quantities are small. Manufacturers have already created opportunities for reprocessing and recycling of panels for themselves. This is also necessary to maintain a good reputation as solar panels are sold as a clean energy manufacturing industry. Since small amounts are recyclable at the moment, it currently takes more money to recycle than one can benefit from this. In future, this may change as quantities increase and, for example, silicon and rare metals become more valuable. If producers consider a re-processing already in production, the products can be designed for easy recycling[46].

During the operational period of solar power plants water consumption must be taken into account. This is especially important because in areas with plenty of sun there is often very little water. Solar-thermal power plants, for example,, require a lot of water, , as electricity is produced using hot steam, and water is also required for cooling. Solar panels must also be washed to ensure that they remain efficient[47].

[43]Clean Energy homepage. Agua Caliente Solar Project: Case Study. http://www.cleanenergyactionproject.com/CleanEnergyActionProject/CS.Agua_Caliente_Solar_Project___Thin_Film_Photovoltaic_Solar_Power_Case_Studies.html
[44]NREL Report No. NREL/FS-520-24619 http://www.nrel.gov/docs/fy99osti/24619.pdf
[45]www.thedailygreen.com/environmental-news/latest/solar-panel-recycling-460810
[46]www.thedailygreen.com/environmental-news/latest/solar-panel-recycling-460810
[47]SEIA homepage. Water Use Management. http://www.seia.org/policy/power-plant-development/utility-scale-solar-power/water-use-management

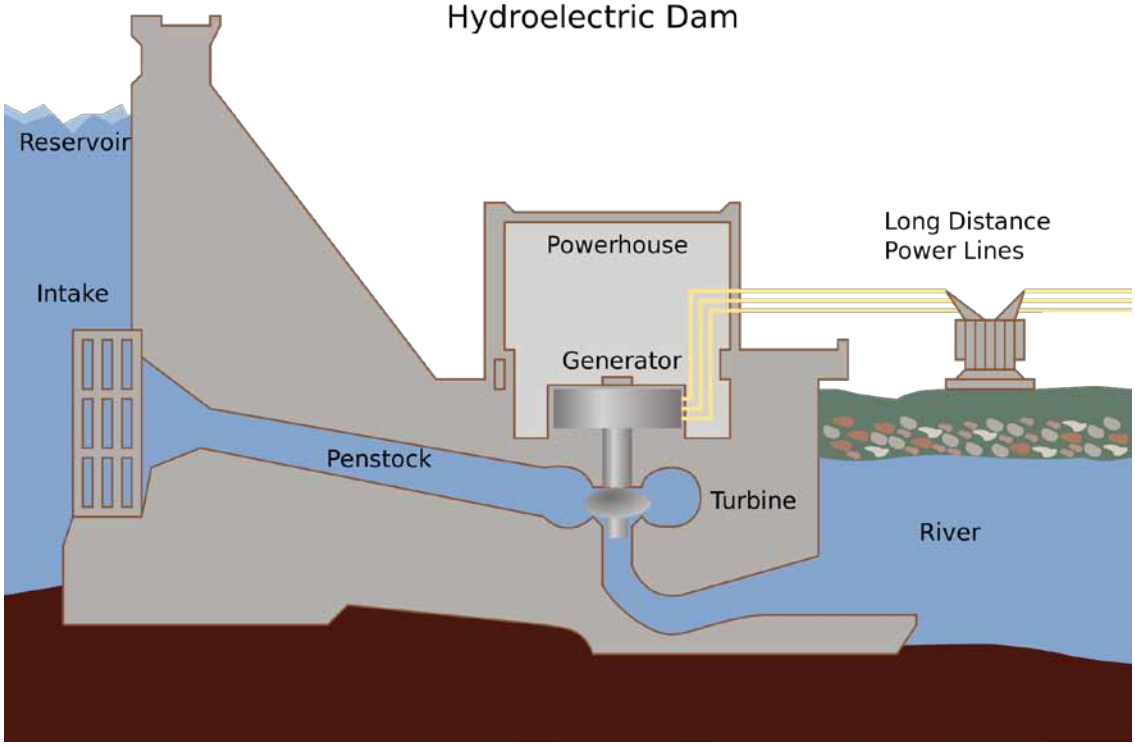
7. HYDROPOWER

The force of flowing water has been used from time immemorial. In ancient Greece and Mesopotamia water mills and irrigation systems were built. Today, hydro power is used mainly to generate electricity. Hydropower is the most widely-used renewable energy, and it represents in total global electricity production about 16% (3,288 TW in 2008)[48] Hydroelectric power stations can be built with very high capacity; the world's largest hydroelectric power station is located on the Yangtze River in China. Its capacity is 22,500 MW and its water reservoir flooded 632 square kilometres. Sometimes energy producing hydroelectric facilities are also used to keep floods under control. Hydropower is quite cheap because once constructed, the operational costs are low, and hydro power plants can successfully withstand deterioration over 100 years[49].

7.2. How can we convert the flow of water into electricity?

The most common way to produce power is to build a dam on the river that generates an upstream water reservoir, an artificial lake, where only a certain amount of water is drawn down along a specific channel. A power station should be built on a river where there is a high flow rate and a large drop - the more water passes through the station and the greater the difference in height, the more electricity can be produced. Water flows from the top down with high speed, making the turbine below rotate and then the water moves back into the river. The kinetic energy of the water turns into mechanical energy by means of the turbine. Rotation of the turbine, in turn, will drive the generator that produces electricity. In addition to large hydro-electric power plants, there are also small power technologies without a dam and a water reservoir and sometimes artificial amounts of flow water are used such as urban water networks.

Hydroelectricity can also include pump-hydro power plants, which do not produce electricity themselves, but store the energy produced (useful for storage of solar and wind energy, the production of which is unstable). For this purpose, two water reservoirs are created, one above and one below, and during peak periods of energy production (e.g., if there are good wind or sun conditions), water is pumped up. If necessary, the upper reservoir is opened, and the water is moving at high speed to the bottom reservoir. Energy of the movement of water is used to generate electricity in the same way as in a hydroelectric power plant.



Drawing 7: Operation principle of the hydroelectric power plant[50]

[48] IEA. 2010. Renewable Energy Essentials: Hydropower http://www.iea.org/publications/freepublications/publication/Hydropower_Essentials.pdf
[49] www.iea.org/publications/freepublications/publication/Hydropower_Essentials.pdf
[50] „Hydroelectric dam“ by Tomia - Own work. Licensed under Creative Commons Attribution 2.5 via Wikimedia Commons - http://commons.wikimedia.org/wiki/File:Hydroelectric_dam.svg#mediaviewer/File:Hydroelectric_dam.svg

>>> NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION - CORRECT AND INCORRECT STATEMENTS*

decision making; discussion

20 Min.

Handouts with text

Participants know the impact of water energy stations.

While hydropower is a relatively favourable and stable renewable energy source, it raises a number of questions. Nature conservationists are particularly concerned about the violation of the balance of the aquatic ecosystem, but there are also social problems associated with the flooding of land.

The classroom will be divided into two parts: One part represents YES and the other part NO. The facilitator introduces the topic and asks students to read the text below. The facilitator then reads out the statements below. Students choose Yes or No and walk to the appropriate side of the room. The facilitator then asks students why they chose a particular side. The students explain their choice and in case the answer is wrong the facilitator gives them the option to choose the right side.

Statements:

1. For fish, hydropower is a problem, because they are looking for food at the hydro power station and die. **WRONG.** Fish migrate upstream to breed, and young fish migrate back downstream.
2. Decline in fish stocks affects residents, as they can no longer catch enough fish. CORRECT
3. Nature conservationists are worried that the biological balance of rivers is upset by hydro plants. CORRECT
4. In order to help the fish, they are collected with nets and taken to the other side of the dam once a day.
5. WRONG. For helping fish, fish ladders, fish gates, etc are built..
6. The fish cannot go upstream to the other side of the dam because they cannot jump so high. CORRECT
7. The river flow volume is greatest in summer, because then the electrical output is at its highest. WRONG. The river flow is typically highest in spring, during the snow melting season, or during large rainfall when there is a lot of water. Then electricity production is high, and the price of electricity is cheaper on the stock market because of the large hydroelectric plants. During droughts (often in the summer) the flow volume is low, and therefore, the output is low.
8. Hydro power necessitates the construction of a dam. As a result, a large area of land is flooded. CORRECT: With the construction of a dam necessary for hydro power a large water tank is created that can be appropriately used. As a result, a large area of land is flooded.

>>> SOCIAL IMPACT OF HYDROPOWER DISCUSSION

presentation; discussion

20 Min.

Handouts with text

Participants understand the social impact of hydropower.

The facilitator introduces the topic or hands out a text to read. The students discuss the topic in groups of four and present their results to the others. The facilitator guides the process. Questions for discussion: which party is right? What could be the solution?

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NATURE CONSERVATION
SOCIAL IMPACT OF HYDROPOWER

NATURE CONSERVATION

The river ecosystem

A dam is a problem for fish because it acts as a migration barrier. Many species of fish (e.g., salmon, trout, vimba) spend their lives at sea but will spawn in river stretches with rapids. These are also the most suitable places for the production of hydroelectric power. However, if a hydroelectric plant is built downstream, it blocks access for the fish to the spawning grounds upstream. Also, river fish migrate sometimes hundreds of kilometres. Therefore, power plants affect a very large number of different species of fish.

For recreational fishermen and the coastal people for whom fishing is the main source of income, a broad decline in fish stocks is a major problem. The decline in fish populations is also a point of concern for nature conservationists. There are fish hatcheries, which populate rivers with fish every year, but this is also a resource cost, better to be avoided. Such an ancillary activity is not a substitute for the natural breeding grounds and habitats that fish require access to in order to preserve the viability of populations.

The amount of water flow varies throughout the year - in spring, it is big but very small during a drought period. It is important that there is enough water in the river in every season. Often it happens that below the dam, the flow is smaller or the riverbed remains dry, at times, which interferes (or destroys) severely the aquatic biota and makes the situation difficult for people living near the river who depend on it.

It is very expensive and difficult to restore rivers that have been damaged by dams to their natural state. Behind the dam a large amount of sediments accumulate, which should not be allowed to go downstream all at once, because it destroys the river biota and its habitats below for a long time. In fact, sediment should be removed from a reservoir regularly, but often this is not done.

The Solution is to construct fish gates, which draw some of the water to the fish ladder or chute where they can move upstream. It should be carefully planned in order for fish to find the right spot and be able to swim upwards. Many fish coming downstream die between the turbines, so the design should also take into consideration ways for fish to get down safely. For small flow rates and capacities the construction of a fish gate is not cost-effective. Its design and construction are expensive, and maintaining a fish gate takes up a portion of the already small flow, so that even less electricity is produced.

See how the fish ladder works: www.youtube.com/watch?v=sabk7Khq0kQ

Flooding of the area of land

The use of hydroelectric energy normally requires a dam and a water reservoir for which a large area of land is flooded. For example, when the Itaipu dam on the border of Brazil and Paraguay was built an area of almost 1,350 km 2 was flooded. Depending on the location and size of the land, people have to be resettled during the construction. This may include indigenous people who depend on their traditions and livelihoods. Also, natural ecosystems and habitats are destroyed. After flooding the area, organic matter growing there begins to decompose and after about ten years the area emits CO_2 [51] .

[51]IPCC Guidelines for National Greenhouse Gas Inventories. 2006. Appendix 2: Estimating CO_2 emissions from lands converted to permanently flooded lands. http://www.ipcc-nggip.iges.or.jp/public/2006gl/pdf/4_Volume4/V4_p_Ap2_WetlandsCO2.pdf

SOCIAL IMPACT OF HYDROPOWER

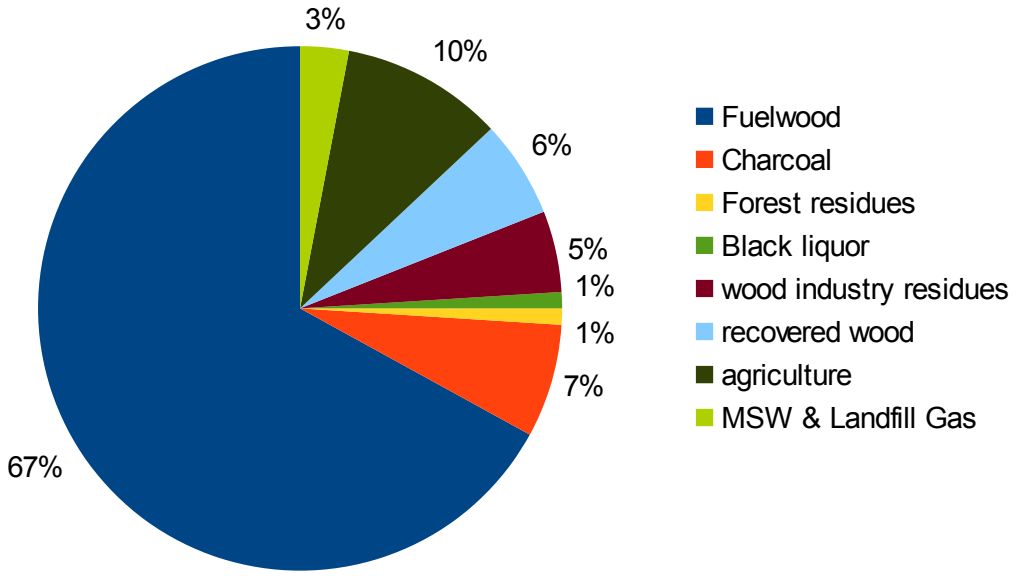
Brazil wants to take advantage of the hydro energy potential of the Xingu River in the Amazon and build a large hydroelectric power station. Conservationists and indigenous people have fought against it for over 20 years, since a large area of land will be flooded, depriving the local people of their living places, and part of the rain forest will stay under water. The Brazilian government has not buried the plan and intends to make it happen as the country's need for energy is growing rapidly.

Read the story in the National Geographic. January 2014 "Kayapo courage" ngm-beta.nationalgeographic.com/2014/01/articles/kayapocourage/

8. BIOENERGY

The energy source of bioenergy is organic material –which can be wood, straw, food waste, sugar cane, rapeseed, manure, algae, etc. From these materials electricity, heat and transport fuel can be produced using a variety of technologies. Electricity and heat are produced mainly from solid biomass; transport fuels are mainly made from liquid biofuels as well as biogas.

Bioenergy accounted in 2008 for more than 10% of the global primary energy production. 80% of this energy was used for heating and cooking[53]. Biofuels globally used for transport accounted for 3% of the total of transport fuels[54].



Drawing 8: Division of the biomass raw materials in the world in the production of primary bioenergy[52]

[53] IEA Bioenergy. Annual report 2012. http://www.ieabioenergy.com/wp-content/uploads/2013/10/IEA-Bioenergy-2012-Annual-Report.pdf
[54]REN 21. Renewables 2013. Global Status Report.
[52]Data: IEA Bioenergy, 2009. Ik 7 http://www.globalbioenergy.org/uploads/media/0908_IEA_Bioenergy_-_Bioenergy_%E2%80%93_A_sustainable_and_reliable_energy_source_ExSum.pdf

>>> HOW CAN BIOMASS BE CONVERTED INTO ENERGY? WORK WITH THE TEXT, DRAWING A PICTURE*/**

Decision making; argumentation; creativity; working together

45 Min.

Handouts with text; 2 big papers; colour pencils; crayons; pastels

Participants know about bioenergy

Step 1:
Every student is provided the following a text. Students read the text individually.

Step 2:
The facilitator divides the class in two or more groups. Then each group jointly draw a picture which show the various types of biomass, their origin, their production or use etc.

>>> NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION - GROUP WORK, WORK WITH THE TEXT**

Decision making; argumentation; presentation

45 Min.

Handouts with text

Participants understand the impact of using biomass.

Divide the class into groups of four and give each member of the group a description from the following page. The students read through the descriptions and explain their topic to the other group members.

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HOW CAN BIOMASS BE CONVERTED INTO ENERGY? TEXT

Nowadays, the most common form of bioenergy for electricity and heat generation is burning solid biomass (e.g., pellets, wood chips). The raw materials are obtained e.g.:

- from forestry - timber with little value and side products of the timber industry (sawdust, bark, etc.)
- from agriculture - the side products of food production (e.g., straw), dry grassy biomass from herbaceous grasslands, energy brush and other energy crops
- from wild lands?, such as reed beds
- Biogas (high methane content) is produced by anaerobic digestion, which is used for electricity and heat production, as well as transport fuel (can be used in cars instead of petrol). It is obtained, for example:
- from wet herbaceous biomass (growing of energy crops, cultivated grasslands, semi-natural grasslands)
- biodegradable household waste
- manure and wastewater
- landfill gas

Biogas production is a good way to use waste. Animal husbandry produces manure which is used in several places in Estonia and the solid material that is left in the production process, can be successfully used as fertilizer on fields.

The transport fuels in use are liquid biofuels such as bio-ethanol and biodiesel primarily. Biodiesel can be mixed with normal diesel fuel up to 7% and bio-ethanol with gasoline up to 10%. If biofuels are used to a greater part, or exclusively, , the engine has to be built accordingly[55]. Liquid biofuels are obtained e.g.from:

- oleaginous crops (rapeseed, sunflower, soybean, etc.) in case of biodiesel
- sugar and starchy crops (sugar beet, cereals) in case of bio-ethanol

These plants have traditionally been used in food production and require fertile farmland. Therefore, biofuel production competes with food production, and this may lead to an overall increase in food prices, as well as impacting negatively on the independence of the national food supply.

These are just some of the common options, but the use of organic matter and energy conversion technologies are ever-evolving.
A diagram summarizing these (but still simplified) can be seen here: www.aebiom.org/wp-content/uploads/2012/08/Bioenergy-routes.jpg

[55]European Biomass Association. About Bioenergy. http://www.aebiom.org/blog/category/about_us/about_bioenergy/

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NATURE CONSERVATION AND ENVIRONMENTAL PROTECTION

The impact on nature and the environment depends a lot on the type of bio-energy, so it is very difficult to make generalizations. Here we will look at some of the key issues.

1) Carbon balance and climate change

In the process of obtaining energy from biomass, greenhouse gases are released, but the same amount is absorbed from the atmosphere by plants while growing.. This means that if the same amount of biomass continually regrows, the bio-carbon cycle of bioenergy is in balance. However, it should be noted that, for example, a forest grows more slowly. Therefore, there may be a long time delay before the new forest stores the same amount of carbon. Also, it must be noted how and where biomass is grown. In Europe there is a growing discussion about the fact that our biodiesel mixture contains a significant amount of palm oil, which is produced at the expense of the destruction of the Indonesian rainforest[56]. Such a change in land use has a negative impact in terms of global warming, as by clearing and burning of forests large quantities of greenhouse gases are emitted into the air. Forests are also very important in terms of biodiversity.

2) Soil fertility and fertilization

If biomass is continually removed, the soil needs to replace the nutrients to maintain its productivity. Previously in forestry, less valuable materials were left in the forest, which to some degree helped to preserve nutrients, but by using these materials for producing bioenergy, very few nutrients remain. The same is happening when energy crops and agricultural products (e.g., straw) are used – important nutrients are removed from fields or grasslands together with biomass.. It is, therefore, necessary to give nutrients back to the soil. Mineral fertilizers are conventionally used for this. Their production needs a lot of resources (including phosphorus the reserves of which are limited).

A greener solution is to use local organic fertilizers such as manure, pre-treated sewage sludge, sewage sludge or combustion ash from the boilers of biomass. Thus a natural substance circulation is achieved when nutrients taken from a field or a forest are ploughed back into it.

3) Eutrophication

Fertilizing must be managed very carefully because when it is done at the wrong time or in the wrong proportion it can lead to nutrients leaching from the soil - primarily phosphorus and nitrogen compounds reach surface waters. These compounds promoting plant growth are useful on fields, but in water they promote the growth of plants and algae that cause eutrophication. The overgrowth of aquatic plants violates the natural balance, decreasing the proportion of oxygen and deteriorating water quality, and this leads to a deterioration of the ecological status of water bodies.

4) A positive effect...

...in terms of nature conservation would be the use of biomass. For excample hay on fallow areas. For now eventually hay is mown in semi-natural communities, but often it remains completely unused. Demand for herbaceous biomass would motivate to use and at the same time to maintain the actually fallow semi-natural areas.

Growing energy crops in abandoned peat production areas would be a positive development since these areas are currently emitting large amounts of greenhouse gases. In Estonia + a study of reed canary grass cultivation in the Lavassaare peat area has shown that this helps to convert the area from emitting carbon to absorbing carbon. No full studies have yet been performed on other environmental impacts associated with grass cultivation. However, it would be very important to do so.

In summary:

Sustainability of bioenergy depends critically on the particular biomass, and on the method of production and use thereof. So in terms of forest and energy crops their sustainability and sustainable management is very important, taking into account nature conservation values and the use of local resources. It is also important to take into account the whole life-cycle starting from the supply and transport of biomass, conversion to the energy carrier and use because in each step there are significant environmental impacts.

[56]Maitar, B. Breaking the Link Between Palm Oil and Deforestation. The Guardian. 26.09. 2013. http://www.theguardian.com/sustainable-business/tighter-standards-palm-oil-deforestation


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