

## LESSON 2

### Aim of the cycle

To help students develop engineering competencies, creatively solve engineering problems in the area of effective use of energy, develop the ability to creatively apply scientific and technological knowledge.

### Objectives of the cycle

The objectives for students are:

- to recognize and observe engineering processes, systems, analyze engineering decisions regarding energy engineering, realize the importance of engineering creations and technological innovations, their relations with natural, social and cultural environment;
- to develop a responsible attitude to various problems of real-life environmental science and sustainable development, as well as the importance of their solutions;
- to study the environment, raise questions, formulate hypotheses, perform, summarize, evaluate research, identify errors and correct inaccuracies, formulate conclusions;
- while learning about the development of modern technologies, get acquainted and analyze engineering

**Topic of the lesson.** Renewable and non-renewable energy resources. Nature-inspired engineering decisions.

### Methods

Understanding students' experience, discussion, exchange of views, brainstorming, presentation of works, demonstration, observe – think – discuss with a friend, demonstration of the filmed material, group work, mutual teaching/learning, self-reflection.

### Materials

Presentations, educational film, computers with access to the Internet, worksheets, pens, paper.

### Objectives

After using various information sources, discussing, working in groups/pairs, watching the film, analyzing the working principle of photosynthesis and respiration, completing written and oral tasks, you will be able to:

- explain the difference between traditional and renewable resources and provide 3-5 examples of them;
- explain which energy resources are the least harmful for the environment;
- provide examples (1-2) where photosynthesis is used by scientists and engineers.

### Content

*Energy Engineering.* Search and analysis of examples of the main problems solved by energy engineering. The variety of energy types and the analysis of possibilities for using them for human needs. Traditional and renewable energy resources, the analysis and perspectives of their possible applications. The regularities of energy transformations, the analysis of their application in engineering solutions, regarding engineering (energy, mechanical engineering, bioengineering, etc.) processes and construction of engineering elements.

*History and Philosophy of Engineering.* Investigation of the problem of engineering and environmental protection, analysis of the possibilities for the problem's solution. Argumentative discussion about the main principles of the engineering science, ethical principles of engineering, the influence of engineering on the development of humanity. Getting familiar with engineering as a discipline for meeting human needs. Getting familiar with engineering activities and social interaction. The description and interpretation of the interdisciplinary problem caused by engineering fields.

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## Activities

### 1. ACTIVITY. PRESENTING THE TOPIC (7 MIN.)

#### 1.1. Revision (1 min.)

The students are suggested to ask each other questions regarding the content material from the previous lesson, e.g.

- What did we learn/find out/remember?

*/ We are surrounded by various forms of energy; one energy type can be turned into another energy type /*

#### 1.2. Revision of the topic of the cycle of lessons

**Cycle:** ENERGY TRANSFORMATIONS. HOW TO USE / APPLY THEM EFFICIENTLY?

#### 1.3. Introduction (5 min.)

##### Questions for discussion:

1. How is electrical energy produced?

*/ It is generated at power stations /*

2. How do power stations produce electrical energy?

*/ They burn fuel or use water, solar, wind energy, geothermal, biomass energy, nuclear energy /*

3. Are the resources eternal/ will they last for a long time?

*/ Not all resources will last for long – some of them are becoming scarce (coal, oil, gas...); some resources are eternal (wind, sun, water, geothermal energy..) /*

4. Do you know how to call the resources which are limited and which are unlimited?

*/ **Non-renewable** and **renewable** energy resources /*

#### 1.4. Announcing the topic of the lesson and discussing the aim and the objectives (1 min.)

**Topic:** Renewable and non-renewable energy resources. Nature-inspired engineering decisions.

Announcing and discussing the aim and objectives of the lesson.

#### Tips for the teacher

- When observing and analyzing students' questions and answers, to find out what students already know, understand and remember from the last lesson.
- During the questions/ answers time, students can be asked specific questions in order to get the right answers.

#### Tips for the teacher

- During the questions/ answers time, students can be asked specific questions in order to get the right answers.
- If the students have problems remembering the answers, they can search for them online or a teacher might remind the information.

#### Tip for the teacher

- Types of resources are written on the board.

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## Objectives:

After using various information sources, discussing, working in groups/pairs, watching the film, analyzing the working principle of photosynthesis and respiration, completing written and oral tasks, you will be able to:

- explain the difference between traditional and renewable resources and provide 3-5 examples of them;
- explain which energy resources are the least harmful for the environment;
- provide examples (1-2) where photosynthesis is used by scientists and engineers.

## 2. ACTIVITY. WATCHING THE FILM AND PERFORMING THE TASK (14 MIN.)

### 2.1. Film demonstration and performing the task (12 min.)

Students are given worksheets *Lesson No.2. Appendix No.1. Translation of the most important concepts from English.*

Teacher and students discuss the most important concepts in English, what they mean and how they are translated.



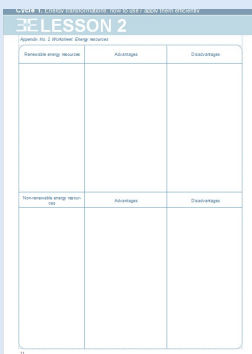
Lesson No.2. Appendix No.1. Translation of the most important concepts from English.

Students are suggested to work in pairs.

### The task is announced:

To fill in the worksheets using the information from the film.

Students are given worksheets *Lesson Nr. 2. Appendix Nr. 2. Energy resources.*



Lesson No.2. Appendix No. 2. Energy resources.

## Tips for the teacher

- The aim and objectives are discussed with students.
- The students' motivation is emphasized – why we concentrate on these objectives; e.g. it is useful in everyday activities, it is interesting, etc.
- The aim and objectives should be not only discussed but it also be attempted to raise them together with students.

## Tip for the teacher

- Depending on the students' English language level, a teacher might present shortly the content of the movie if there is a need.

## Tips for the teacher

- Suggestion to work in pairs. If students wish, they can work individually.
- It should be reminded that the task should take about 10 min. (students could keep track of time by themselves).
- It is recommended that, while searching for answers, students would have an opportunity to use the Internet.
- If there is a need, the film might be watched again.

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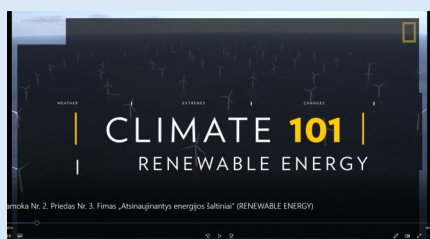
Students are asked to tell:

- renewable and non-renewable energy resources;
- write their advantages and disadvantages.

Teacher and students discuss the task. The teacher makes sure that all students understood the task.

Students complete the task.

Watching the film *Lesson No.2. Appendix Nr. 3. Film. Renewable energy resources* (RENEWABLE ENERGY).



Lesson No.2. Appendix No. 3. Film. Renewable energy resources (RENEWABLE ENERGY).

## 2.2. Presenting and discussing the task (2 min.)

After completing the task, students present their works, discuss and comment on their answers.

### Tip for the teacher

- A teacher asks for students' pairs (2-3) to present answers. Other students might add more information to the answers.


## 3. ACTIVITY. DISCUSSION (6 min)

### 3.1. Understanding experience (3 min.)

Students are asked to remember the film "Renewable energy resources" (RENEWABLE ENERGY).

#### Question:

- Did you understand what biomass is?

*/ Biomass is an organic matter in which the certain amount of energy is captured during photosynthesis,  useful info /*

#### Questions:

1. Why are plants important to the planet and human beings?

*/ They clean the air, soil; provide food for animals and human being /*

2. How do plants clean the air?

*/Absorb carbon dioxide and release oxygen/*

3. Can you tell how the process is called and how it happens?

*/ It is photosynthesis – the process by which plants use sunlight to synthesize sugar and oxygen from carbon dioxide and water /*

### Tip for the teacher

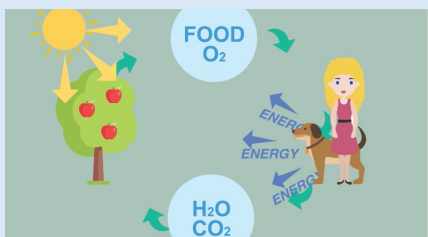
- During the discussion the students are supposed to answer the questions.

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## 3.2. Demonstration and analysis of the slide (3 min.)

A teacher shows the slides *Lesson No.2. Appendix No.4. Photosynthesis and energy*.

The activity principle of photosynthesis and respiration is presented.



*Lesson No.2. Appendix No.4. Photosynthesis and energy.*

Students are asked to explain the connections between photosynthesis, respiration and energy ① *useful info*.

All answers are discussed together with students.

*/ It should be emphasized that photosynthesis is a very useful process during which carbon dioxide is absorbed and oxygen is released. Oxygen is needed for respiration. During respiration the energy derived from food is released /*

### Tips for the teacher

- A teacher asks if all students understand the task.
- If there is a need, the task should be explained once again.

### Tip for the teacher

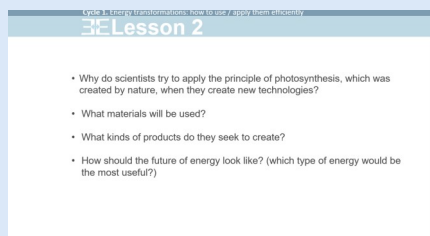
- Students should be allowed to use all available sources of information (mobile phones, computers with access to the Internet, etc. )

## 4. ACTIVITY. PERFORMING THE TASK (15 min.)

### 4.1. Announcing the task (1 min.)

To find out what artificial photosynthesis is using various information sources (the Internet, manuals, students' books, etc.).

Students are given questions *Lesson No.2. Appendix No. 5. Presentation*, which will facilitate searching for the relevant information and present it.




*Lesson No.2. Appendix No. 5. Presentation.*

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## Questions:

1. Why do scientists try to apply the natural process of photosynthesis while creating new technologies?
2. Which materials will be used?
3. What products are intended to be created?
4. What should be the energy of the future? (what kind of energy would be the most useful)?

useful info 

### 4.2. Performing the task (5 min.)

Students are asked to perform the task.

### 4.3. Discussing the task in groups/preparing of the presentation (4 min.)

When the task is finished, students are asked to sit in groups and discuss the new information, prepare the answers and presentations on the provided questions.

### 4.4. Presentations (5 min.)

The students are asked shortly (1 min. per group) to present their works. Presentations are discussed and commented on,

*/ It should be emphasized that people search for new alternative energy resources and technologies in order to reduce the use of*

## 5. ACTIVITY. REFLECTION (3 min)

*fossil fuel /*

Students' assessment and self-assessment, how they succeeded to achieve the objective of the lesson, what the personal progress of each student is.

### Recommended questions:

1. What did I do during the lesson? Did I succeed?
2. Do you know renewable and non-renewable energy resources? Can you say something about them? Please raise your hands who can answer the question.
3. What could I do next time in order to work more efficiently/ complete all tasks during the given time/ be more cooperative during the group work, etc. ?

### Tip for the teacher

- *Each group might be given sheets of paper, pens or a suggestion might be made to complete the works and presentations using the computer programs.*

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## POTENTIAL DIFFICULTIES

There might be too many activities or too much information for the classroom of younger students. A teacher should decide which and how many activities will be carried on, depending on the age and working pace of the students.

## TERMS AND USEFUL INFORMATION

Possible answers (the task „Lesson No. 2. Appendix No. 2. Energy resources“):

Renewable energy resources	Advantages	Disadvantages
Solar energy	The use of these energy sources slows down the climate change because they do not release greenhouse gases;	Energy is difficult to accumulate; the technologies and equipment, which are necessary to convert their energy into other types of energy, are expensive;
Wind energy	the energy from these sources is much "cleaner", more environmentally friendly, reducing the risk to our health;	the recovery of energy is not constant (the sun shines and the wind blows variably);
Hydropower (flowing water, sea waves, floods)	their resources are not finite and very large (especially solar energy), they are constantly renewed;	the amount of energy generated is not as high as that derived from fossil fuels;
Biomass energy	these energy sources are reliable and the prices of energy produced by them are stable.	sometimes wind energy devices can harm animals and the environment.
Geothermal energy (the Earth's internal heat)		
Non-renewable energy resources	Advantages	Disadvantages
Coal Oil Natural gas	The energy generated by burning these resources is quite cheap.	These energy sources are finite and will eventually disappear;  When burning the resources, many pollutants are released into the environment, including carbon dioxide (CO <sub>2</sub> ), which increase in the atmosphere causes the climate change.
Nuclear	Nuclear power plants produce low-cost electricity continuously and ensure price stability.	When producing electricity, highly hazardous radioactive waste is made;  Nuclear power plants are only operational for about 30 years, and it is very difficult and costly to shut them down;  electrical failures can have catastrophic consequences for human

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## TERMS AND USEFUL INFORMATION

**Renewable energy resources** – natural resources which creation and renewability are determined by natural processes. It is solar, wind, geothermal, water, biomass energy. The use of these resources for energy production is favorable to the environment and contributes to the stabilization of climate change. Despite the fact that the use of renewable energy resources for energy production is still more expensive than traditional energy production, the use of these resources is increasing rapidly. Governments are developing and implementing a range of mechanisms to encourage new technology developers, manufacturers and investors to engage in the renewable energy market all over the world.

**CO<sub>2</sub> – carbon dioxide.** Its release to the atmosphere annually strengthens the greenhouse effect all over the world. In the industrially advanced countries, CO<sub>2</sub> emissions account for more than 80% of greenhouse gas emissions.

**Fossil fuels** - coal, oil, natural gas. The current civilization mainly uses these non-renewable energy sources. Over the last few centuries, these resources have been rapidly exhausted for energy production and transportation using huge amounts of fossil fuels.

**Climate change** - unpredictable changes in weather conditions, causing many problems for the planet's fauna, flora and human beings. Combustion of fossil fuels entails the release of various pollutants, including CO<sub>2</sub>, which being increased in the atmosphere promotes the climate change.

**Greenhouse effect.** Solar energy heats the Earth's surface, and the atmosphere works like a greenhouse: it lets the visible light into the interior and absorbs infrared energy, thus keeping the heat inside the greenhouse. Such a natural process is called the "greenhouse effect". If this did not exist, the average annual temperature would be - 18 ° C, and now it is + 15 ° C. However, due to human activities, emissions of greenhouse gases, in particular of carbon dioxide, methane and nitrous oxide, are very high. Therefore, the greenhouse effect is strengthened and global temperature rises.

**Biomass** is an organic substance in which a certain amount of energy is accumulated by photosynthesis. This type of energy, like wind energy, is closely related to solar energy. Organic materials can be called accumulated solar energy. Biomass is a collection of various renewable organic materials (plants and agricultural waste and residues, food processing waste and similar organic materials).

**Photosynthesis** - is the process of producing sugar and oxygen when exposed to light from carbon dioxide and water. Photosynthesis occurs on leaves because their cells consist of chlorophylls containing chlorophyll, the substances giving the plants a green color. As a result of the sugar and oxygen reaction, all living organisms (plants and animals) emit energy. This occurs in most living cells.

**Artificial photosynthesis** is the production of fuel only from water, sunlight and carbon dioxide. This is a very important process that would allow abandoning the use of fossil fuels. Combining carbon dioxide with water, hydrocarbons are produced during the artificial photosynthesis. Hydrocarbons, consisting of hydrogen and carbon, such as propane and octane, are the main components of gasoline and natural gas and have been used as fuel for centuries. In addition, this type of artificial photosynthesis is superior as it reduces carbon dioxide in the atmosphere.



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