CZYSTA MOC ENERGII

LESSON TOPIC

Why is it worth saving energy and how can we do it best?

Grades **7**
Time **45 min.**

The lesson plan for seven-grade elementary school students was prepared by Jakub Wiech, a lawyer, journalist, and columnist specializing in energy, editor-in-chief of the Energetyka24.com portal, popularizer of knowledge in this field, and author of the podcast "Elektryfikacja"

OBJECTIVES IN LINE WITH THE CORE CURRICULUM

in the field of general education:

- The student understands what energy transition is;
- The student understands the impact of energy on the climate and everyday life;
- Students develop critical thinking and teamwork skills.

INTRODUCTION

he teacher asks the students about the prices of sample food products, e.g. bread rolls, water, chocolate bars. Then the teacher asks about the price of one kilowatt-hour of electricity.

A kilowatt-hour (kWh) – is a unit of energy used to measure its production or consumption. If a device has a power of 1 kilowatt (i.e. 1,000 watts) and operates for 1 hour, it consumes 1 kilowatt-hour of energy. For example, an average electric kettle has a power rating of 2 kilowatt hours and consumes 2 kWh during one hour of continuous operation. The average Polish household consumes approximately 2,000 kWh per year.

Currently, the price of 1 kWh in Poland is approximately PLN 1.2.

PART 1

The teacher asks the students to point out the difference between goods such as bread rolls or drinks and electricity.

The best answer is that:

there are no significant differences, because from an economic perspective, 1 kilowatt-hour of electricity is the same commodity as, for example, 1 bottle of water or 1 bread roll. All are subject to the same economic laws – when there is little energy and demand for it is high, its price rises. When there is a lot of it and demand is low, the price falls.

Key conclusion:

energy is a commodity just like bread rolls, drinks or chocolate bars. Unfortunately, we know much less about energy and its prices than we do about the prices of chocolate bars, for example. This is despite the fact that we consume significantly more kilowatt-hours of energy per day than chocolate bars.

LECTURE

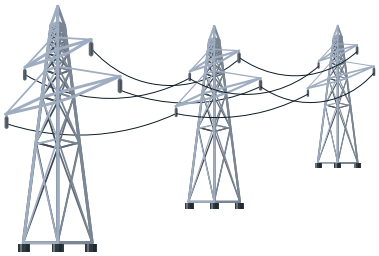
PART 2

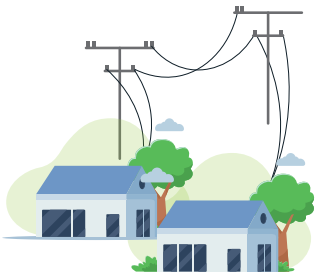
The teacher presents the key factors affecting the price of electricity to the students and analyses an example of an electricity bill.

The price of electricity depends on the sources from which it comes. Energy sources can be broadly divided into conventional and renewable. .

- Conventional sources include coal, gas and nuclear power plants. .
- Renewable sources include wind turbines, photovoltaic panels and hydroelectric power plants.

The value chain for electricity is as follows:





GENERATION → **TRANSMISSION** → **DISTRIBUTION**

GENERATION

includes costs related to electricity production, e.g. fuel purchase (a key factor for conventional sources), costs related to power plant management (construction, maintenance, employee salaries), and the producer's margin (i.e. profit that allows power plants to earn money).

TRANSMISSION

includes costs related to the operation of transmission infrastructure, i.e. high-voltage lines that transport energy over long distances. The entire management system in Poland is controlled by one institution – Polskie Sieci Elektroenergetyczne which is the operator of the power system.

DISTRIBUTION

includes costs related to the delivery of energy directly to end users via low and medium voltage lines. The distribution segment is managed by a number of energy companies.

This means that the price of electricity shown on the bill is primarily the sum of the costs resulting mainly from these three links in the value chain. For example:

The cost of electricity from a coal-fired power plant will be the sum of the following component costs: The cost of fuel (i.e. coal) + the cost of emission allowances (calculated under the ETS system) + the producer's (i.e. the power plant's) margin + transmission costs + distribution costs.

However, these are not all the charges that appear on your electricity bill. The electricity bill that households receive includes the following cumulative costs:

The price of active energy (i.e. the price per 1 kWh of „clean" energy, depending on the tariff offered by the seller), **fixed and variable network charges** (i.e. the costs of maintaining the power grid), **quality charges** (set by Polskie Sieci Elektroenergetyczne, related to the supply of electricity with specific quality parameters), **subscription fee** (related to the costs of customer service provided by the energy seller), **transitional fee** (characteristic of the Polish power system, which does not use long-term energy contracts), **capacity fee** (related to the so-called capacity market, i.e. a mechanism for securing the supply of capacity in the system), **RES fee** (supporting the development of renewable energy sources) **and taxes: excise duty and VAT.**

In summary: energy costs money. It is not the case that electricity is free and can sourced from the socket. In order for devices such as lamps, computers or televisions to work, tens of thousands of people work across the country and huge amounts of raw materials and equipment are needed. All this generates costs of various kinds. Not only financial, but also, for example, environmental.

Since we already know that energy is a commodity just like bread rolls, for example, it is worth to follow the same rules as we apply to food. The key point here is not to waste them. Saving energy brings a number of benefits.

The economic benefits are at the forefront – saved energy means lower bills. Lower bills, in turn, mean more money in your wallet. In short, the less we spend on electricity, the more money we have for other goods. This balance is expressed by the concept of **opportunity cost.**

The opportunity cost is what you have to give up when you choose something else. For example, if you have PLN 10 and you can buy either a pizza or ice cream, when you choose the pizza, **the opportunity cost is that you will not eat ice cream.**

In the case of energy saving:

if you spend an additional PLN 100 per month on electricity used unwisely, the opportunity cost is that you will not be able to buy, for example, a T-shirt or a computer game for that PLN 100.

According to energy market experts, the cheapest energy is the energy that is not consumed. To better express the scale of savings in this area, the concept of a negawatt was created.

A negawatt is saved energy – electricity that has not been consumed, even though it could have been.

Importantly, saved energy does not only mean more money in your wallet. It also means measurable environmental and climate benefits. This is particularly important in Poland, a country whose energy sector is one of the most emission-intensive in the world.

Energy sector emission intensity – a measure of how much greenhouse gases are released into the air when we produce electricity, expressed in CO2 equivalent per kilowatt-hour (grams of CO2/kWh).

In terms of specific figures, the current emission intensity of the **Polish energy sector is approximately 600 grams of CO2 equivalent/kWh.** This means that the generation of each kilowatt-hour is associated with the emission of 0.6 kg of CO2 equivalent. Therefore, saving energy also means reducing greenhouse gas emissions and, as a consequence, relieving the burden on the environment and climate.

To simplify things a little, we can say that the annual carbon footprint of a Polish household resulting from electricity consumption is on average 1.2 tonnes of CO2.

Saving just 5% of this energy (i.e. 100 kWh) also means saving 60 kilograms of CO2.

If all households in Poland made such savings, it would mean a reduction in their emissions by 0.9 million tonnes.

Meanwhile, saving 100 kWh can be achieved very easily. For example, in a household of 4-5 people, an electric kettle used 4-5 times a day to boil 1 litre of water each time can consume 150-250 kWh per year. However, statistically speaking, people tend to use this appliance rather unwisely, e.g. by boiling more water than they need or forgetting about water that has already been boiled, which then cools down and has to be boiled again. Placing a refrigerator next to an oven can increase the energy consumption of the fridge by up to 20%, as the oven operating nearby hinders the refrigerator's performance. In older or larger models, this can mean an additional 50-70 kWh of energy consumption per year.

EXERCISES

PART 3

TASK 1

The teacher divides the class into groups (4-5 people) and asks each group to calculate the annual energy consumption of sample appliances based on their power and usage time.

Examples of appliances:

- Refrigerator – 200 watts
- Electric kettle – 2,000 watts
- Hair dryer – 1,500 watts
- Computer – 300 watts
- Television – 150 watts

Energy consumption is calculated using the formula:

power x usage time.

TASK 2

The teacher divides the class into groups (4-5 people) and asks each group to prepare an energy saving plan for their homes or flats, as well as for their region and country.

Sample suggestions:

- Turning off lights when they are not needed
- Switching off appliances completely, rather than just putting them into standby mode
- Using natural light during the day
- Placing household appliances in appropriate locations (e.g. the refrigerator away from the oven)
- Boiling only as much water as is needed in the kettle
- Renovating public buildings
- Promoting energy efficiency through appropriate regulations
- Education and public awareness campaigns

SUMMARY

PART 4

Recapitulation of the knowledge acquired; consolidation through discussion.