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ENGLISH FOR POWER ENGINEERING STUDENTS

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Кафедра «Английский язык №1»

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Пособие
для студентов специальности
7-07-0712-01 Электроэнергетика и электротехника

Минск БНТУ 2025

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Данное пособие по английскому языку предназначено для студентов специальности 7-07-0712-01 Электроэнергетика и электротехника. Целью пособия является формирование и развитие профессиональной иноязычной коммуникативной компетенции.

Пособие состоит из 8 разделов, объединенных по тематическому принципу. Каждый раздел включает аутентичный текстовый материал, лексические задания, а также широкий спектр упражнений, направленный на формирование у обучающихся речевых навыков и развитие умений профессионально ориентированного иноязычного общения в устной и письменной форме в предполагаемых ситуациях профессиональной деятельности.

Пособие также включает ссылки на интерактивные задания.

CONTENTS

UNIT 1
THE IMPORTANCE OF ELECTRICITY

Let's warm up!

What comes in your mind when you hear the word "Electricity"? Write down at least 5 words or word combinations. Work in pairs and justify your choice of words and word combinations.

Let's read!

Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully and learn more about the widespread use of electricity in the modern day.

Electricity is one of the most important innovations that people cannot live without in the modern day. It is one of the most essential blessings that science has given to mankind and it is vital for a human existence. Electricity has significantly improved some aspects of modern life, technology, and economy.

1. **Light** First and foremost, the use of electricity for lighting up light bulbs is the biggest reason why we need electricity in our lives. The light bulbs provide light to us and we can perform our tasks even after it is dark.

2. **Domestic Appliances** Today, everyday products and appliances (a TV, a fridge, an iron, an electric bulb, a microwave, a dishwasher, a vacuum cleaner, a heater, a computer, etc.) are electrically powered. Humans have become dependent upon these household appliances because even one day without these products is unimaginable and they make our life easier, safer, more comfortable and more interesting. Moreover, access to electricity reduces the burden and time required for household work.

3. **Hospital and Medical Facilities** Electricity also allowed us to become healthier. Without it, hospitals would have significantly less medical equipment like X-ray, computerized tomography (CT scan), positron emission tomography (PET scan), etc. that is necessary for making a proper diagnosis. Electricity saves lives and allows people to live longer.

4. **Environmentally Friendly Vehicles** Subways and electric buses are the main forms of public transport for many countries. Other than that, in recent years, many leading automobile companies have successfully developed electric cars or electric bikes because they don't create harmful by-products such as

carbon dioxide emissions and don't cause air pollution, climate change and global warming.

5. **Industrial Sector** The importance of electricity in industrial operations is the basis of a country's economy. The industries that used manual labor and manual machines for operations are now using electricity. It has made these operations easier, cheaper and faster. This has resulted in achieving profits, increasing the production line, making better quality products.

6. **Communication** The world without the Internet and communication is impossible to imagine. With electrically powered gadgets, computers, mobile phones, laptops, people now communicate with each other no matter how far the distance is. The Internet invention has made everybody more aware of the world they live in, and it has allowed us to learn about our surroundings and life all over the world. Especially under the current circumstances – pandemic and lockdown – it has given a wide range of possibilities to perform online classes, e-commerce industry, to work from home, etc.

7. **Electricity in Space** One can think that the importance of electricity is only limited to the earth, but it isn't true. The electricity has reached space as well. The satellites that are sent to space have to be there for a longer period. It requires electricity to run because transporting other fuel ways to space is dangerous and very expensive. This is why electricity is generated inside the satellite or space stations. Access to space is made possible because of electricity.

8. **Entertainment Industry** We can't imagine our lives without entertainment appliances and equipment because life will become very dull without it. The employment of high-quality cameras used in shooting movies or dramas runs on electricity. Other than that, cinemas are dependent upon electricity for their smooth running. Similarly, the use of VCR and DVD players in old times which started the rise of the entertainment industry cannot and should not be forgotten.

9. **Heating** Electricity is also required for leisure and comfort of the people. Electric heating systems are convenient because they are easy to use and maintain. You can simply turn them on and off as needed. They are very efficient, meaning that they convert a large percentage of the electricity they consume into heat. They can be a cost-effective way to heat your home, especially if you use a programmable thermostat to regulate the temperature. They are a clean source of energy because they do not produce any emissions from the location they are based in.

10. **Electricity on Streets** The street lights that are lighting up our streets are an unspoken blessing for the people of the 20th and 21st centuries. People can walk and work peacefully even at night because the electricity is lighting up the streets and roads for us.

These are just some of the advantages of electricity.

But there are also some disadvantages and issues:

Firstly, power plants that generate electricity use a variety of energy sources, some of which may pose a risk to human health and the environment. For example, burning biomass releases sulfur dioxide and nitrogen oxides, which can cause respiratory diseases, and carbon dioxide released during the burning of fossil fuels affects climate change and the species composition of flora and fauna.

Secondly, electricity is expensive. One of the primary reasons for expensive electricity costs is the rising demand for fuel. Electricity is still largely generated through the burning of fossil fuels that are non-renewable. Once these resources disappear, the world will definitely suffer. People need to learn how to value electricity and learn how to produce it from renewable sources that are being discovered and developed.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) renewable	a) equipment	загрязнение воздуха
2) global	b) satellite	ручной труд
3) household	c) work	вредный побочный продукт
4) medical	d) pollutant	основное загрязняющее вещество
5) fossil	e) appliance	возобновляемый источник
6) major	f) pollution	космический спутник
7) harmful	g) warming	ископаемое топливо
8) climate	h) fuel	изменение климата
9) space	i) source	медицинское оборудование
10) manual	j) by-product	бытовой прибор
11) domestic	k) change	работа по дому
12) air	l) labor	глобальное потепление

Exercise 4. Match each word to its synonym.

1) cost-effective	a) to illuminate
2) to light up	b) to carry out
3) to perform	c) household
4) application	d) costly
5) domestic	e) employment
6) reason	f) humanity
7) expensive	g) cause
8) dangerous	h) hazardous
9) mankind	i) fundamental
10) vital	j) profitable
11) to improve	k) to use
12) to consume	l) to upgrade

Exercise 5. Match each word to its antonym.

1) comfortable	a) useless
2) to reduce	b) pollution-free
3) essential	c) dull
4) dangerous	d) to increase
5) expensive	e) depletable
6) interesting	f) unpleasant
7) necessary	g) safe
8) healthy	h) unimportant
9) harmful	i) sick
10) renewable	j) cheap

Exercise 6. Match the word to its definition.

1) electricity	a) a device or tool specifically designed to perform a particular function
2) mankind	b) the action of accomplishing something
3) emission	c) all of the living human inhabitants of the earth
4) convenient	d) a degree or grade of excellence or worth
5) achievement	e) a physical phenomenon associated with stationary or moving electrons and protons
6) appliance	f) the release or discharge of a substance, such as gases, particles, or energy, into the environment
7) to value	g) the act of using or expending something in order to fulfill a need or desire
8) domestic	h) evaluate or estimate the nature, quality, ability, extent, or significance of something
9) quality	i) suited to your comfort or purpose or needs
10) to consume	j) relating to the running of a home or to family relations

Exercise 7. Translate the following compound word combinations into Russian.

1. electrically powered gadget –
2. cost effective way –
3. environmentally-friendly vehicle –
4. carbon dioxide emission –
5. to value manual labor –
6. to reduce household work –
7. global warming reason –
8. convenient heating system –
9. under the current circumstances –
10. to cause air pollution –
11. to burn fossil fuel –
12. high quality product –
13. to provide smooth running –
14. to create harmful by-products –

Exercise 8. Complete the sentences with the words in the box.

environmentally-friendly, air pollution, housework, improve, fossil fuels, gadget, by-product, convenient, appliance, carbon dioxide

1. Cars are still one of the principal contributors to _____ _____.
2. This _____ was cheaper than I expected.
3. I shop here because it's _____ .
4. _____ _____ have caused irreversible damage to the environment.
5. We're working hard to _____ the situation.
6. Don't plug in an electrical _____ with wet hands – you could get an electric shock.
7. They use _____ fabrics in their clothing made from recycled plastic bottles.
8. There has been a sudden and worrying rise in the level of _____ _____ in the atmosphere.
9. Modern devices such as washing machines, vacuum cleaners and steam irons make _____ easier.
10. In order to minimize waste, we need to explore alternative uses for the _____.

Exercise 9. Find twenty-one household appliances in the puzzle. Read across, down, and diagonally.

S	C	I	E	G	S	T	O	A	S	T	E	R	Z	C	V	R	F
T	O	K	G	L	A	P	T	O	P	E	S	K	I	B	P	L	A
O	N	Q	M	O	Q	V	Y	E	S	K	E	T	T	L	E	F	N
V	D	A	I	H	B	I	L	B	S	J	Y	H	Z	I	B	R	Z
E	I	I	C	V	I	L	S	Q	Z	F	U	O	E	P	K	E	M
T	T	W	R	U	G	H	E	L	U	C	R	I	V	A	W	E	I
K	I	H	O	Z	F	X	B	N	A	L	D	I	C	E	T	Z	X
W	O	E	W	K	N	U	K	Q	D	M	V	R	D	E	N	E	E
G	N	W	A	S	H	E	R	V	V	E	P	H	Y	G	R	R	R
T	E	R	V	L	I	R	O	N	U	J	R	D	Z	E	E	J	A
G	R	K	E	P	H	O	N	E	G	H	O	O	V	E	R	Y	H
E	G	D	I	S	H	W	A	S	H	E	R	G	U	D	L	C	K

Exercise 10. Answer the following questions.

1. Why is electricity essential for the functioning of medical facilities?
2. How do electric vehicles contribute to environmental improvement?
3. How does electricity support the development of industry and a country's economy?
4. What role does electricity play in modern education?
5. How does electricity impact the entertainment industry?

6. Why is electricity important for the operation of satellites and space stations?
7. What household appliances rely on electricity, and how does this affect daily life?
8. What disadvantages related to electricity are mentioned in the text?

Let's listen and watch!

Exercise 1. Watch the video and answer the following questions.

1. How do power stations generate electricity?
2. What are some renewable sources of electricity mentioned in the video?
3. How do batteries work to produce electricity?
4. In what different ways is electricity used in our daily lives?
5. What are electric vehicles and how are they changing transportation?
6. Why is it important to use electricity safely?

Exercise 2. Watch the video from 2:58 to 4:16 and make a list of prescriptions that should be followed for the safe and wise use of electricity.

1. To reduce energy consumption.
2. …
3. …
4. …
5. …
6. …
7. …
8. …

Let's speak!

Read these facts about electricity. Choose the 3 facts that you think are the most surprised. Work in pairs and exchange your thoughts.

1. Electricity powers 95% of the world's technology today.
2. The first electric power plant opened in 1882 in New York City.
3. Around 1.3 billion people live without reliable electricity globally.
4. Electricity can travel at nearly the speed of light, around 186,282 miles per second.
5. Around 70% of the electricity in homes is used for heating and cooling.
6. Electricity generation accounts for over 30% of global greenhouse gas emissions.
7. Solar energy production increased by 300% within the last decade.
8. Electric vehicles are projected to comprise 70% of new car sales by 2040.

Let's write!

Imagine waking up one day and all forms of electricity have disappeared. Write a short paragraph describing how your day would change and how you would adjust to this new reality.

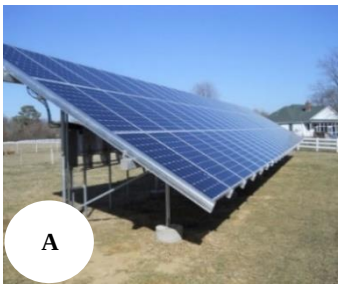
UNIT 2
FOSSIL FUEL ENERGY

Let's warm up!

Exercise 1. Read the following note about fossil fuels and name their types.

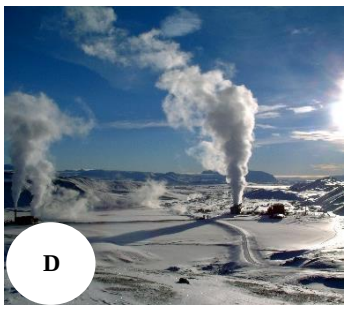
Fossil fuels are sources of energy that make our cars drive, heat and cool our houses, help us cook our food and run all the machines that do various things in our cities and towns. Most of the energy you use in your house to charge your phones and iPads, watch TV and run the electronics you love to play with comes from fossil fuels.

Exercise 2. Choose the pictures relating to fossil fuels.


A


B


C


D


E


F


G


H

Exercise 3. Test your knowledge on fossil fuels by answering the following questions in pairs.

1. What do you know about fossil fuels and their role in our energy consumption?
2. How do you think the use of fossil fuels affects the environment?
3. How does your community rely on fossil fuels for transportation or heating?
4. What changes have you noticed in discussions about energy sources over the years?
5. How important is it for governments to invest in renewable energy technologies?
6. In your opinion, what are some challenges we face when trying to reduce fossil fuel usage?
7. What steps do you think people should take to become more aware of their energy choices?

<u>Let's read, listen and watch!</u>

Exercise 1. Follow the QR code and learn the words.

Exercise 2. Watch the video and say:

1. when fossil fuels were formed;
2. what they were formed from;
3. how they were formed;
4. under what conditions they were formed;
5. why they couldn't form everywhere;
6. what major types of fossil fuels there are;
7. why fossil fuels are sought after energy sources;
8. how people use fossil fuels;
9. what disadvantages they have.

Exercise 3. Watch the video again and complete the video script. The first letters of the missing words are given.

Fossil fuel is a term used to describe a group of energy sources that were formed from [1]**a**_____ plants and organisms during the [2]**C**_____ period approximately from 360 to 286 million years ago even before the age of [3]**d**_____. At that time the land was covered with [4]**s**_____ filled with organisms and plants. As they died they sank to the bottom of swamps and oceans and over millions of years started [5]**d**_____ under layers of sand, [6]**c**_____ and other minerals. Different types of fossil fuels formed depending on the combination of organic matter, temperature, time and [7]**p**_____ conditions while decomposing.

There are three major types of fossil fuels: [8]**c**_____, oil and natural gas. Coal was formed from ferns, plants and trees which [9]**h**_____ due to pressure

and heat. Oil was formed from small organisms like [10]**z**_____ plankton and algae where pressure caused the more complex organic matter to decompose. Natural gas was formed by the same process as oil only was exposed to more [11]**h**_____ and pressure causing it to further decompose and turn into a [12]**g**_____ form.

Fossil fuels are [13]**s**_____ after energy sources because they have a high energy [14]**d**_____. They are the world's dominant energy source. Fossil fuels have a variety of [15]**a**_____ from [16]**e**_____ production to transport fuels. They can also be used to make a variety of common products from [17]**p**_____ to cosmetics to even some medicines. These resources have powered [18]**i**_____ over history and continue to do so today.

Fossil fuels can be an [19]**a**_____ and cheap or in some cases a [20]**s**_____ and expensive form of energy depending on geographic [21]**l**_____. For this reason, geopolitical issues arise due to scarcity caused by the natural geographic allocation of these highly [22]**v**_____ resources.

Fossil fuels are considered non- [23]**r**_____ resources because they take millions of years to form which means that once they are used the resources will not be [24]**r**_____ in a human lifetime. The gradual [25]**d**_____ of the most accessible fossil fuel reserves have forced companies to develop technologies for extracting more challenging or unconventional reserves. In many cases this means additional safety and environmental concerns as well as higher costs. Fossil fuels are also the largest [26]**e**_____ of carbon dioxide, a greenhouse gas which causes climate change. In addition, their production causes both environmental and human health [27]**i**_____. These concerns have triggered society to look at alternative sources of energy that are more environmentally sustainable and renewable. That’s fossil fuels.

Exercise 4. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) zoo	a) depletion	ископаемое топливо
2) natural	b) location	географическое расположение
3) organic	c) density	углекислый газ
4) gradual	d) fuel	источник энергии
5) swamp	e) gas	животный планктон
6) energy	f) matter	доступный запас
7) geographical	g) resource	энергетическая плотность
8) carbon	h) source	природный газ
9) power	i) lifetime	постепенное обеднение
10) valuable	j) plankton	ценный ресурс
11) fossil	k) dioxide	дно болота
12) human	l) bottom	продолжительность жизни человека
13) accessible	m) reserve	органика

Exercise 5. Match each word to its synonym.

1) to decompose	a) influence
2) approximately	b) silt
3) oil	c) about
4) impact	d) lack
5) issue	e) to decay
6) clay	f) problem
7) scarcity	g) to be filled with
8) to be full of	h) petroleum

Exercise 6. Find Russian equivalents to the following English words.

1) layer	a) древний
2) fern	b) оседать на дно
3) ancient	c) слой
4) to sink	d) разлагаться
5) heat	e) папоротник
6) scarce	f) давление
7) to extract	g) тепло
8) to replenish	h) затвердевать
9) abundant	i) преобразоваться
10) to emit	j) быть востребованным
11) application	k) применение
12) to turn into	l) имеющийся в избытке
13) to harden	m) скудный, дефицитный
14) to decompose	n) восполнять
15) pressure	o) выделять
16) to be sought after	p) добывать

Exercise 7. Choose the correct answer.

1. What was the main cause of the formation of fossil fuels?
    a. Volcanic activity
    b. Decomposition of ancient plants and organisms
    c. Compression of sedimentary rocks
    d. Chemical reactions in the Earth's crust

2. Which of the following types of fossil fuels was formed from small organisms like zooplankton and algae?
    a. Coal
    b. Oil
    c. Natural gas
    d. Peat

3. Which of the following is NOT a common product made from fossil fuels?
    a. Plastics
    b. Cosmetics
    c. Medicines
    d. Biofuels
4. What is the primary reason fossil fuels are considered non-renewable resources?
    a. They are not found in sufficient quantities.
    b. They take too long to replenish.
    c. They are too expensive to extract.
    d. They are harmful to the environment.
5. What has been the main consequence of the depletion of accessible fossil fuel reserves?
    a. Increased investment in renewable energy
    b. Stricter environmental regulations
    c. Technological advancements in extraction
    d. Higher prices for consumers
6. Which of the following is a major environmental concern associated with the use of fossil fuels?
    a. Loss of biodiversity
    b. Depletion of freshwater resources
    c. Increased greenhouse gas emissions
    d. Soil erosion
7. What does the passage suggest as a potential solution to the issues surrounding fossil fuels?
    a. Continued reliance on fossil fuels with improved extraction methods
    b. Transition to a balanced mix of fossil fuels and renewable energy
    c. Immediate and complete abandonment of fossil fuels
    d. Increased investment in carbon capture and storage technologies

Exercise 8. Complete the following sentences using the words in the box.

organic matter, ferns, natural gas, extract, emissions, abundant, scarce, algae, oil, coal

1. _____ have been around for millions of years and can be found in a wide variety of habitats around the world.
2. It is important to _____ the key points from the lengthy report to create a concise summary.
3. Many cosmetic and skincare products, such as face masks and moisturizers, contain extracts from _____ due to their hydrating and nourishing properties.

4. At present, industrial hydrogen is produced from _____ _____ using a process that consumes a great deal of energy while also releasing carbon into the atmosphere, thus contributing to global carbon _____.
5. This will be key to finding the best outcomes and will make best use of _____ resources for what is a priority across the city region.
6. The price of crude _____ has a significant impact on global economies.
7. _____ reserves are estimated to be _____ in several countries, including the United States, China, India, and Australia.
8. _____ _____ refers to any material that was once alive or derived from living organisms.

Exercise 9. Find fifteen words related to fossil fuels in the puzzle. Read across, down, and diagonally.

D	E	C	O	M	P	O	S	E	G	X	X	B	A	C	A	G	U
D	A	B	U	N	D	A	N	T	P	A	Z	P	Y	Y	F	X	L
H	Y	J	D	X	M	W	Y	I	Z	X	S	Z	J	C	W	X	H
D	Q	D	E	N	S	I	T	Y	C	E	X	T	R	A	C	T	W
Y	C	Q	P	S	C	A	R	C	I	T	Y	S	W	A	M	P	B
O	V	M	L	G	C	B	K	Z	U	A	A	L	G	A	E	Z	F
P	F	F	E	W	I	N	A	C	C	E	S	S	I	B	L	E	E
Y	M	U	T	G	E	F	R	K	F	E	R	N	P	I	U	I	M
S	B	Z	I	C	C	A	P	L	A	N	K	T	O	N	M	Y	S
E	L	I	O	A	B	P	L	M	I	C	O	A	L	D	T	G	R
P	F	O	N	C	O	L	V	A	L	U	A	B	L	E	J	V	Z
Z	Y	B	M	T	Z	Z	C	L	A	Y	E	R	B	R	L	U	P

Let's speak!
Read these facts about fossil fuels. Choose the 3 facts that you think are the most surprised. Work in pairs and exchange your thoughts.

1. Fossil fuels were formed over 300 million years ago from ancient plants and animals.
2. The European Union has been actively working to reduce fossil fuel usage as part of its Green Deal. Many EU countries are investing heavily in renewable energy sources and have set ambitious targets to become carbon-neutral by 2050.
3. Natural gas is often considered a "bridge fuel" in the transition from coal to renewable energy sources because it emits less CO_2 when burned compared to coal.
4. Oil is still the largest source of energy globally, making up 31%.
5. Burning fossil fuels releases over 35 billion metric tons of CO_2 annually.

6. A recent study published in the BMJ found that 8.3 million deaths are caused by air pollution each year, with 61% of those caused directly by fossil fuels *(The BMJ – a monthly international medical journal)*.
7. Although we typically harness fuel to create energy, it can also be used to make a variety of products. Any time you use something with plastic components, you may be handling the result of fossil fuel. For example, a water bottle may have been made with oil or coal that was extracted from the earth's crust and modified to become a plastic.
8. About 80% of the world's energy comes from fossil fuels.
9. With the current rate of usage of coal, this resource could last another 1,000 years. We have enough oil to last about another 100 years. If our consumption goes up by 5 percent, our current resources could run out sooner than expected.
10. Renewable energy could replace fossil fuels by 2050 if adopted widely.

Let's write!

Translate the following sentences into English using your active vocabulary.

1. Горючие полезные ископаемые образовались из растений и организмов в каменноугольный период палеозойской эры.
2. В те времена землю покрывали болота полные растений и микроорганизмов, которые отмирали, оседали на дно и миллионы лет разлагались под слоями ила, песка и других минералов.
3. Каменный уголь формировался из папоротников, деревьев и других растений, которые затвердевали под воздействием давления и высокой температуры.
4. Нефть формировалась из более сложной органики (мелких организмов, таких как зоопланктон и водоросли).
5. Природный газ формировался так же, как и нефть, но органика подвергалась воздействию более высокой температуры и большего давления, вследствие чего преобразовывалась в газообразную форму.
6. Горючие полезные ископаемые очень востребованы.
7. Они обладают высокой удельной энергетической плотностью.
8. Спектр применений горючих полезных ископаемых огромен.
9. Невозобновляемые источники энергии не смогут вновь пополниться, если иссякнут.
10. Горючие полезные ископаемые – самый крупный источник выбросов углекислого газа.

UNIT 3
HYDROPOWER

Let's warm up!

Discuss the following questions in pairs.

- What are the main advantages and disadvantages of hydropower compared to other renewable energy sources?
- How do environmental impacts, such as effects on local ecosystems and fish populations, influence the development of hydropower projects?
- How does climate change affect the viability and reliability of hydropower as a renewable energy source?

Let's read!

Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully to find out how hydropower technology was developed.

Hydropower is electricity generated using the energy of moving water. Rain or melted snow create streams and rivers that run to the ocean.

This energy has been exploited for centuries. The Ancient Greeks used water wheels to grind wheat into flour. Placed in a river, a water wheel picks up flowing water in buckets located around the wheel. The kinetic energy of the flowing river turns the wheel and is converted into mechanical energy that runs the mill.

Hydropower became a source for generating electricity. The first hydroelectric power plant was built at Niagara Falls in the late 19th century.

A typical hydro plant is a system with three parts: an electric plant where the electricity is produced; a dam that can be open or closed to control water flow; and a reservoir where water can be stored. The water behind the dam flows through an intake and pushes against blades in a turbine, causing them to turn. The turbine spins a generator to produce electricity. The latter can be transported over long-distance electric lines to homes, factories and businesses.

Hydroelectric power provides almost one-fifth of the world's electricity. China remains the world leader in respect of total hydropower installed capacity with over 370 GW. So, China, Brazil (109 GW), the United States (102 GW), Canada (82 GW) and India (50 GW) were the top five largest producers of hydropower in 2021. Hydropower is the cheapest way to generate electricity today. That's because once a dam has been built and the equipment installed, the energy source – flowing water – is free. It's a clean fuel source that is renewed yearly by snow and rainfall.

There are some **disadvantages** of hydropower:

1. Damming rivers may destroy or disrupt wildlife and other natural resources;

2. The presence of hydroelectric dams changes the migration patterns of fish (salmon, for example) and hurts its populations;

3. Constructions need a large area, it means that we flood a lot of lands;

4. Initial costs are significantly high (the average cost of building a small hydropower plant is $10 million);

5. Most of the hydropower plants suffer from silt erosion and cavitation problems. So, the maintenance costs are often 3-5% of the capital value of the asset;

6. Hydropower plants can also cause low dissolved oxygen levels in the water, which is harmful to river habitats.

Hydropower offers **three major advantages** when it comes to producing clean energy that can help our planet combat climate change:

1. It is flexible energy. This means that, thanks to the fact that the amount of water that passes from its natural or artificial source to the turbines can be controlled, the generation of energy is always adapted to the needs of the moment, thus avoiding waste. Likewise, the stored water, in addition to being used to produce energy, can also be used to supply the surrounding communities in case of need;

2. It is clean energy. The production of electricity through the use of water does not produce waste. This does not happen with other energies, such as nuclear or fossil fuel energy, which is the main cause of climate change;

3. It is safe energy. Due to the high safety standards of dams and reservoirs, accidents due to water leaks are nowadays very unlikely, which makes hydroelectric energy a very safe alternative.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) long-distance	a) wheat	водяное колесо
2) to install	b) costs	продолжительный срок службы
3) water	c) inhabitant	низкий уровень кислорода
4) to run	d) performance	рыбоход, рыбоподъёмник
5) hydroelectric	e) wheel	приводить в движение мельницу
6) fish	f) lifetime	устанавливать оборудование
7) river	g) power plant	первоначальные затраты
8) long	h) electric line	высокая производительность
9) high	i) the mill	молоть пшеницу
10) low oxygen	j) equipment	гидроэлектростанция
11) initial	k) ladder	протяжённая линия электропередач
12) to grind	l) level	речной обитатель

Exercise 4. Match each word to its synonym.

1) to exploit	a) harmful
2) accessible	b) to generate
3) to save	c) pollution-free
4) impact	d) to spin
5) to produce	e) available
6) to damage	f) to supply
7) to turn	g) efficiency
8) hurtful	h) influence
9) to install	i) to hurt
10) eco-friendly	j) to store
11) to provide	k) to use
12) performance	l) to set up

Exercise 5. Match the following words and word combinations to their definitions.

1) water wheel	a) an artificial lake where water is collected and kept in quantity for use
2) dam	b) a series of pools arranged like steps by which fish can pass over a dam in going upstream
3) intake	c) a rotary engine actuated by the reaction or impulse or both of a current of fluid (such as water, steam, or air) subject to pressure and usually made with a series of curved vanes on a central rotating spindle
4) reservoir	d) providing good value for the amount paid
5) blade	e) a machine for converting the kinetic energy of flowing or falling water into useful forms of power, often in a watermill
6) turbine	f) the duration of the existence of a living being (such as a person or an animal) or a thing (such as a star or a subatomic particle)
7) fish ladder	g) an arm of a screw propeller, electric fan, or steam turbine
8) lifetime	h) the machinery, tools, etc. that you need to do a job
9) cost-effective	i) a structure built across a stream, a river, or an estuary to retain water
10) equipment	j) an opening through which fluid enters an enclosure

Exercise 6. Complete the sentences with the words in the box.

upstream, salmon, reservoir, impact, generate, emissions, nonrenewable, habitat, rainfall, fish ladder, spawning, hydroelectric plant, water wheels

1. The barrage also incorporates a _____ _____ to allow fish to get from the tidal water to the fresh water and vice versa.
2. Many historic sites still showcase the remains of _____ _____ from centuries ago.
3. The _____ provides a _____ for various aquatic plants and animals.
4. The earthquake had a devastating _____ on the region.
5. Heavy _____ caused flooding in several areas.
6. The kayakers paddled _____ against the current.
7. The company is aiming to be carbon neutral and reduce _____ to zero.
8. The river is teeming with _____ during _____ season.
9. Oil is a _____ resource that is being depleted at an alarming rate.
10. The _____ _____ needs to _____ more electricity.

Exercise 7. Answer the following questions.

1. What is hydropower? What kind of electricity is it?
2. How has hydropower been utilized historically before becoming a source of electricity?
3. What energy does the flowing river have? What energy runs the mill?
4. When and where was the first hydroelectric power plant built?
5. What are the three main components of a typical hydro plant system? What are their functions?
6. How does a hydroelectric power plant produce electricity?
7. What part of the world's electricity does hydroelectric power provide?
8. Which countries were the top five largest producers of hydropower in 2021?
9. Why is hydropower considered the cheapest way to generate electricity today?
10. Why is hydropower a clean fuel source?
11. What are the consequences of damming rivers?
12. Why do we have to flood a lot of lands?
13. What is the average cost of a small hydroelectric power plant?
14. Why is hydropower renewable and readily-available?
15. What inventions help to save fish and its populations?

Exercise 8. Work in pairs and say whether the following statements are true or false. Correct the false ones.

1. Hydropower is generated by the energy of moving air.
2. The first hydroelectric power plant was constructed at the Grand Canyon.

3. China has the highest total hydropower capacity in the world.
4. Hydropower plants do not have any negative impact on fish populations.
5. The initial costs of building a small hydropower plant are low.
6. Hydropower plants can lead to low oxygen levels in river habitats.
7. Hydropower is the most expensive way to generate electricity.
8. Fish ladders are used to disrupt fish migration patterns.

Let's listen and watch!

Exercise 1. Watch the video and match the following words and word-combinations with their Russian equivalents.

1) run-of-river dam	a) повышать
2) barrier	b) пользоваться спросом
3) to raise	c) сила
4) elevation	d) доля
5) force	e) русловая дамба
6) to release	f) неустойчивый, непостоянный
7) to be in demand	g) подъём
8) variability	h) препятствие, преграда
9) intermittent	i) конкурентно способный
10) whopping	j) высвобождать
11) share	k) прибрежный
12) cost-competitive	l) колоссальный
13) base-load	m) проблема
14) concern	n) изменчивость
15) riverside	o) базовый, минимальный

Exercise 2. Watch the video again and complete the video script.

Hydropower, or hydroelectricity, refers to the [1]**c**_____ of energy from flowing water into electricity. It is considered a renewable energy source because the water cycle is constantly renewed by the [2]**s**_____ . One of the first uses of hydro energy was for mechanical milling, such as grinding [3]**g**_____ . But today, modern hydro plants produce electricity using [4]**t**_____ and [5]**g**_____ . The mechanical energy created by moving water spins rotors on a turbine. This turbine is connected to an electromagnetic generator which produces electricity when the turbine [6]**s**_____ .

There are two main types of hydroelectricity production, [7]**d**_____ and [8]**r**_____ Hydro-dams utilize the potential energy from dammed water to produce electricity. A dam is a large [9]**b**_____ constructed to raise the level of water and control its [10]**f**_____ . The elevation created by the dam creates gravitational force for turning the turbine when water is released. Some dams also contain an additional [11]**r**_____ at their base where water is stored to be pumped to the higher reservoir for release when electricity is in [12]**d**_____ .

The second form of hydroelectricity production is a run-of-river dam. Because it is subject to natural water variability, it is more intermittent than a dam.

There are various sizes of hydro plants that produce electricity. Large hydro, greater than 30 megawatts. Small hydro, 100 kilowatts to 30 megawatts, and micro hydro less than 100 kilowatts. The [13]**H**_____ dam in the United States is a [14]**w**_____ power of 2,074 megawatts, which is enough to serve 1.3 million people. Of all renewable energy sources, hydropower holds the largest [15]**s**_____ of worldwide electricity production.

Hydropower has several [16]**b**_____ . It is a [17]**c**_____ form of electricity, even though the initial building cost can be high. It is quite [18]**r**_____ because water can be used as [19]**b**_____ power. In some cases, dammed reservoirs can also help with flood control and be a reliable water [20]**s**_____ .

There are also some [21]**c**_____ with hydropower, especially when it comes to large dams. Damming a river has a major [22]**i**_____ on the local environment, changing wildlife habitats, blocking [23]**f**_____ passage, and often forcing people in riverside areas to move out of their homes. In addition, dam failures can be catastrophic, claiming the lives of those living [24]**d**_____ . Hydro plants are also not completely free of greenhouse gas [25]**e**_____ . As with most forms of energy, [26]**c**_____ dioxide emissions happen during construction, particularly due to the large quantities of [27]**c**_____ used, and plant matter in the flooded areas makes [28]**m**_____ , another greenhouse gas, as it [29]**d**_____ underwater. That's hydropower.

Exercise 3. Answer the following questions in pairs.

1. What does hydropower mean and why is it grouped as a renewable energy resource?
2. When did people first use hydropower?
3. What part does a turbine serve in generating hydroelectric power?
4. What does an electromagnetic generator do in a hydro plant?
5. In the video, the main types of hydroelectric power creation are revealed to be twofold. What are they?
6. What is the process by which hydro dams create electricity from gravity?
7. In what ways does run-of-river hydro differ from dammed hydro and why is it said to be intermittent?
8. In which sizes do hydro plants come and how much power do they produce?
9. What is the number of people the Hoover Dam can power with electricity?
10. Why do some consider hydropower to be competitive when installation is costly?
11. What sorts of environmental problems arise from constructing large hydroelectric dams?
12. Why are hydro plants not completely free of greenhouse gas emissions?

Let's speak!

Read these opinions. Which one do you agree with the most and why? Work in pairs and exchange your thoughts.

Let's write!

Create an informational text explaining how dams work, focusing on the different types of dams and their impact on local ecosystems.

UNIT 4
WAVE POWER

Let's warm up!
Discuss the following questions in pairs.

- What do you think wave energy is?
- Do you know how waves are formed in the ocean?
- What are the main advantages and disadvantages of wave power compared to other renewable energy sources?
- In which regions of the world is wave power most viable, and what factors contribute to its potential success in those areas?

Let's read!
Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully to find out how different wave power plants generate electricity.

Wave power is one of the most promising renewable energy sources. There are three key factors that make electricity production from water more sustainable and environmentally-friendly. Firstly, 71 % of the Earth's surface is covered by water. As a result, there is a very large territory in which to operate.Secondly, water is 800 times denser than air, which means that a wave power plant can generate large amounts of energy. Thirdly, water is constantly moving: rainfall, flowing rivers, and tides. Constant movement results in a large amount of kinetic energy, which can be harnessed to generate electricity.

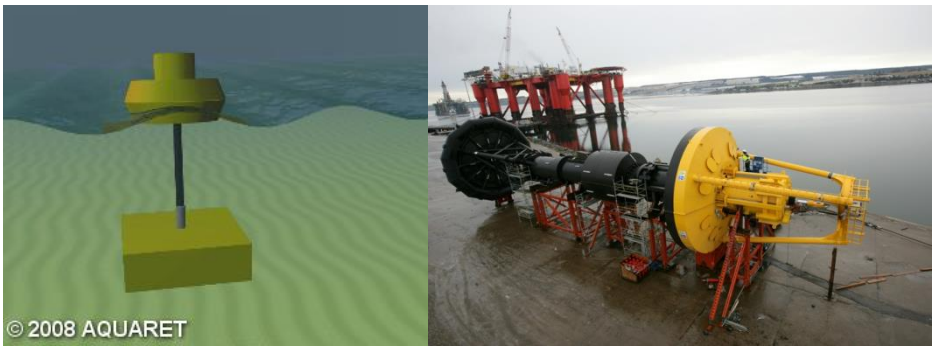
Ocean waves are both clean and renewable sources of energy with a tremendous worldwide potential of generating electricity. If wave energy is fully exploited, about 40% of the world's power demand could be supplied by this resource – equivalent to as much as 800 nuclear power plants.

Wave energy is a form of solar energy. Winds are generated by the heating of the earth. As winds move across the open surface of water, they create waves. Energy is stored in waves as both potential energy and kinetic one. The amount of energy transferred and hence the size of the resulting waves depends on the wind speed, the length of time for which the wind blows and the distance over which it blows.The wave energy output is measured by wave speed, wave height, wavelength and water density.

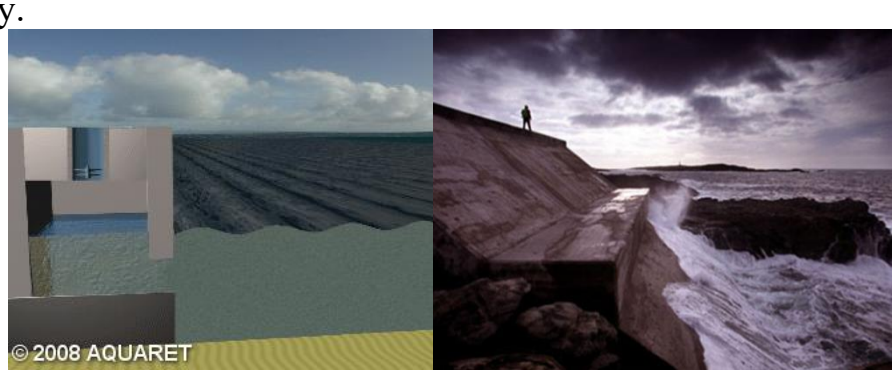
Wave power is the transport of energy by ocean surface waves, and the capture of that energy does useful work: electricity generation, water desalination and the pumping of water (into reservoirs).

There are five main types of wave power plants:

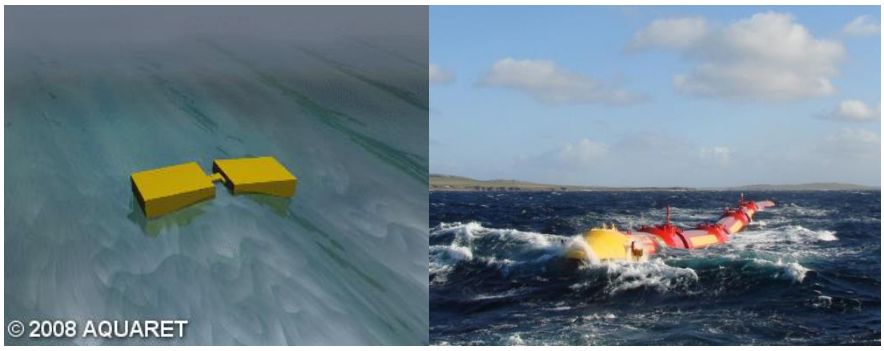
1. **Absorbers** are floating structures that extract energy from movements on the surface. The kinetic energy is converted to electricity using linear or rotary generators.



2. **Oscillating water columns** are partially submerged structures. When waves travel in and out, it forces air through turbines at the top of the structure. Movement of the turbines powers a generator, converting their kinetic energy into electricity.

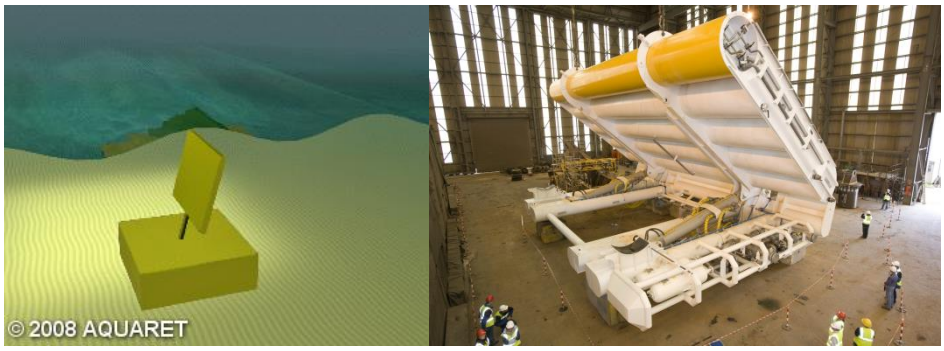


3. **Attenuators** have hinged 'arms', extracting energy from their relative movements. They are connected to hydraulic pumps, which convert the kinetic energy into electricity.



4. **Overtopping devices** function like tidal barrages, trapping water and releasing it through turbines. Movement of the turbines powers a generator, converting their kinetic energy into electricity.

5. **Oscillating wave surge converters** have a hinged paddle, extracting energy from its relative movement. The paddle's motion drives hydraulic pumps, which power generators to convert kinetic energy into electricity.



The advantages of wave energy:

1. *Reliable*. Water power is not influenced by weather conditions or the time of year.
2. *Renewable*. Water is constantly moving and cycling around the Earth. It will never run out – so energy from water can always be harnessed.
3. *Energy efficient*. Water is dense. The larger the mass of an object, the more kinetic and gravitational energy it has. Thus, more energy can be harnessed and converted to electricity. So, water-based power is a highly efficient form of energy generation.
4. *Cost-effective*. Once in operation, it's cheap to produce electricity using water power plants.
5. *Economic advantages*. Using renewable energy resources such as water power reduces the reliance on imported fossil fuels and creates job opportunities.
6. *Clean energy*. Land remains undamaged in its natural state. Wave energy plants are situated offshore and reduce any risk of soil pollution.
7. *Innovative*. Capturing wave energy and converting it into electricity is a difficult task but this allows innovative devices to be designed.

The disadvantages of wave energy:

1. *Ecological problems*. Constructing wave power plants alters the nearby environment. Habitat damage and flooding are common side effects. Wave power plants are associated with thermal and noise pollution.
2. *High initial cost*. Constructing wave power plants is expensive. However, it's expected that construction costs will fall as technology improves.
3. *High maintenance costs*. The equipment used is subjected to constant water exposure and requires regular maintenance to prevent corrosion and ensure its use.
4. *Lack of accessibility*. Approximately one-fifth of the world's countries (44) are landlocked.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) oscillating	a) power	загрязнение почвы
2) wave	b) desalination	приливное устройство
3) energy	c) device	извлекать энергию
4) overtopping	d) consumption	опреснение воды
5) to extract	e) demand	колебательный водяной столб
6) water	f) pollution	потребление энергии
7) power	g) country	волновая электростанция
8) sustainable	h) power plant	спрос на электроэнергию
9) soil	i) energy	устойчивая энергетика
10) landlocked	j) water column	страна, не имеющая выхода к морю

Exercise 4. Match each word to its synonym.

1) amount	a) to power
2) to harness	b) huge
3) sustainable	c) to decrease
4) tremendous	d) transfer
5) to reduce	e) viable
6) to drive	f) quantity
7) transport	g) to provide
8) to supply	h) to exploit
9) shortage	i) to capture
10) to trap	j) lack

Exercise 5. Match the word to its antonym.

1) partially	a) surplus
2) to capture	b) useless
3) constantly	c) to release
4) lack	d) impossible
5) viable	e) completely
6) strong	f) sometimes
7) useful	g) weak

Exercise 6. Match the following words and word combinations to their definitions.

1) promising	a) relating to forms of energy that are produced using the sun, wind, etc., or from crops, rather than those using fuels such as oil or coal
2) wave	b) the process of removing salt and other minerals from water
3) renewable	c) to allow a substance to flow out from somewhere
4) to reduce	d) the relationship between the mass of a substance and its size
5) to drive	e) to use something completely so that nothing is left
6) desalination	f) a need for something to be sold or supplied
7) to release	g) to provide the power to keep a machine working, or to make something happen
8) density	h) a raised line of water that moves across the surface of an area of water, especially the sea
9) to run out	i) showing signs of future success or achievement
10) demand	j) to make something less in size, amount, degree, importance, or price

Exercise 7. Translate the following word combinations into Russian.

1. constant movement –	7. tremendous potential –
2. promising source –	8. energy efficient –
3. large amount –	9. length of time –
4. fossil fuel –	10. energy output –
5. key factor –	11. nuclear power plant –
6. weather conditions –	12. water density –

Exercise 8. Complete the sentences with the words in the box.

water columns, weather conditions, sustainable, offshore, soil pollution, tide, seawater, water density, landlocked countries, extract

1. The industrial waste has led to severe _____ _____ in the surrounding area.
2. Oscillating _____ _____ have no moving parts in the water, and therefore pose little danger to sea life.
3. The energy system must switch as soon as possible to renewable and _____ sources of energy.
4. Ocean currents are driven by a range of sources: the wind, tides, changes in _____ _____, and the rotation of the Earth.
5. This was especially the case for _____ _____, which depended heavily on relatively more expensive land transport.
6. The company is building a plant that will desalinate _____.
7. He made a mistake of trying to _____ further information from our director.
8. Ocean-based sources of marine litter include the shipping and fishing industry, military fleet and research vessels, _____ platforms and fish farming installations.
9. The basin is designed to release 250 million US gallons (950,000 m^3) of water captured at high _____ twice a day.
10. _____ _____ make it impossible for airplanes to take off.

Exercise 9. Form the nouns from the columns A (adjectives) and B (verbs).

A	**B**
1. long –	1. to consume –
2. dense –	2. to move –
3. high –	3. to absorb –
4. accessible –	4. to rely –
5. hot –	5. to produce –
6. efficient –	6. to exploit –
7. reliable –	7. to transport –
8. effective –	8. to generate –
9. economic –	9. to perform –
10. innovative –	10. to convert –
11. typical –	11. to maintain –
	12. to corrode –

Exercise 10. Answer the following questions.

1. Why is wave power one of the most promising renewable energy sources?
2. Could wave power replace other energy sources and in what circumstances?
3. What kind of energy is wave power closely linked?
4. How are the wind and waves formed?
5. What two forms of energy is wave power stored in?
6. What does the amount of energy transferred depend on?
7. What is the wave energy output measured by?
8. What useful work does wave power do?
9. What types of wave energy devices do you know and what is their main function?
10. What are the advantages of wave power?
11. What disadvantages of wave power do you know?

<u>Let's listen and watch!</u>

Exercise 1. Watch the video and match the following words and word-combinations with their Russian equivalents.

1) truly unmatched	a) сходство, подобие
2) to sound bizarre	b) *(зд.)* чистая энергия
3) similarity	c) шлюз
4) spine	d) рычаг
5) gateway	e) поистине недооценённый
6) raw power	f) продуктивный
7) fruitful	g) основа, каркас, хребет
8) lever	h) странно звучать
9) chunk	i) змееобразный
10) serpent-looking	j) устройство отбора мощности
11) wearing and tearing	k) часть, кусок
12) power take-off	l) ежегодно
13) untapped market	m) износ и разрыв
14) annually	n) нетронутый рынок

Exercise 2. Watch the video again and say whether the following statements are true or false. Correct the false statements.

1. The Waveline Magnet uses the gravitational force of falling water to generate energy.
2. Wave energy could potentially provide over half of the electricity needed in the U.S. annually.
3. The Waveline Magnet has been in development for more than a decade.
4. Wave energy production is most efficient during the summer months.

5. The main challenge of using wave energy is the high cost of installing wave converters.
6. Seawater is highly corrosive due to its combination of moisture, oxygen, and salt.
7. The Waveline Magnet generates energy by pressurizing seawater.
8. Wind turbines and wave energy converters work on the same principle of capturing kinetic energy.
9. The Waveline Magnet was tested off the coast of California.
10. Bacteria in seawater can contribute to the corrosion of wave energy devices.

Exercise 3. Answer the following questions in pairs.

1. How does the process of wave energy generation compare to wind energy in terms of efficiency?
2. What does the Waveline Magnet's structure look like, and how does it work?
3. What challenges do startups face when developing wave energy technology?
4. How does wave energy influence on the environment?
5. Why do waves produce more energy in winter?
6. Why is seawater more corrosive than freshwater, and how does this affect wave energy technology?
7. What factors determine the amount of energy that can be harvested from waves?
8. How feasible is wave energy as a primary power source for homes in the near future?
9. Why might wave energy be a better option than solar or wind energy in certain locations?

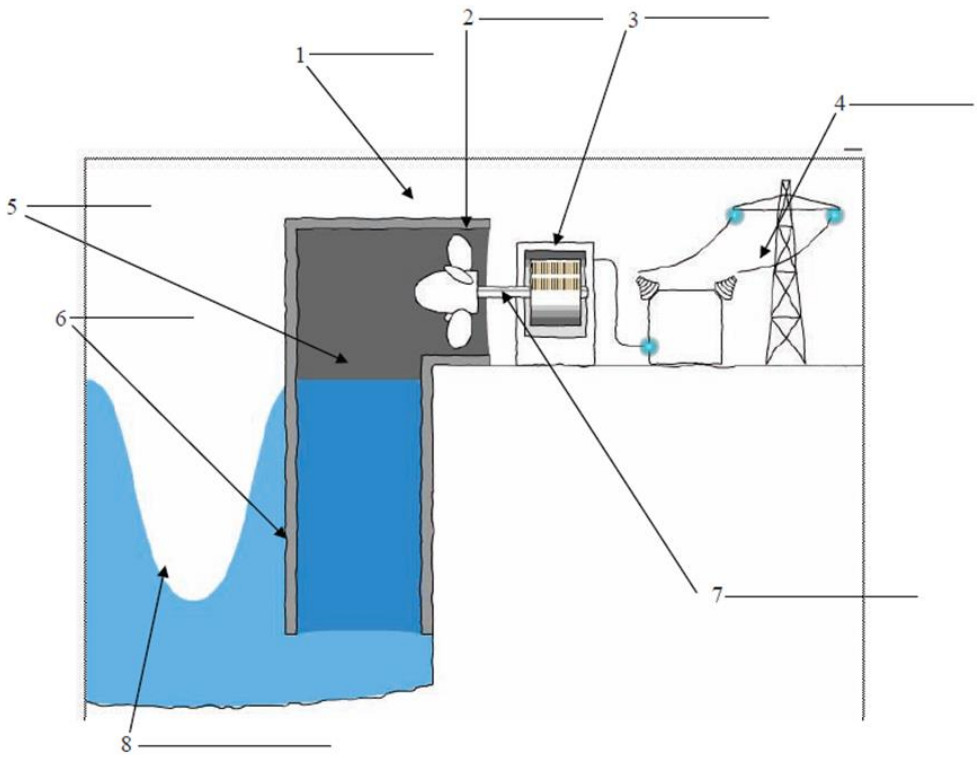
Let's speak!

Read these facts about wave energy. Choose the 3 facts that you think are the most surprised. Work in pairs and exchange your thoughts.

1. Wave energy can generate up to 5 times more power per square meter than solar panels in ideal conditions.
2. A single kilometer of wave energy devices can power over 10,000 homes annually.
3. Scientists have developed smart buoys that not only generate power but also monitor climate and ocean pollution.
4. By 2040, over 200 commercial wave energy plants are expected to be operational, mostly along the coasts of South America and Australia.
5. Experimental wave stations in Japan continued operating even after an 8.0-magnitude earthquake and a tsunami.
6. Wave energy is one of the quietest power sources — its noise level is lower than that of most marine animals.

7. The first floating city powered entirely by wave energy is under development off the coast of Norway.
8. Some next-gen wave converters use AI to adapt in real time to changing wave patterns, boosting efficiency by 40%.

Let's write!



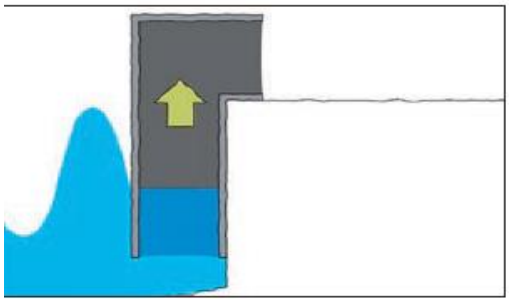
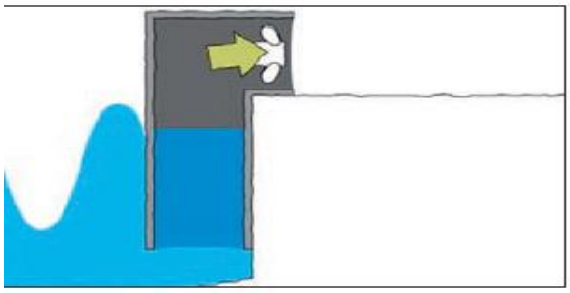
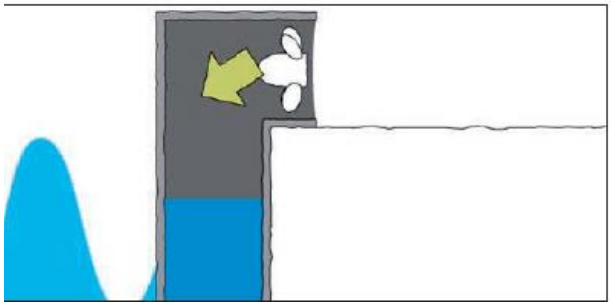
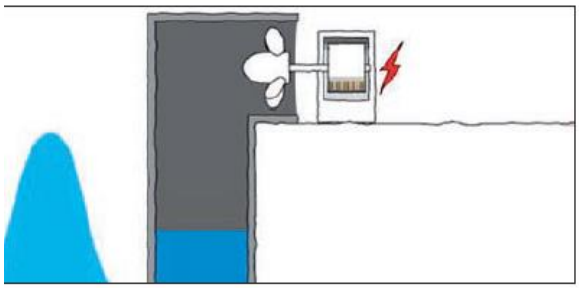
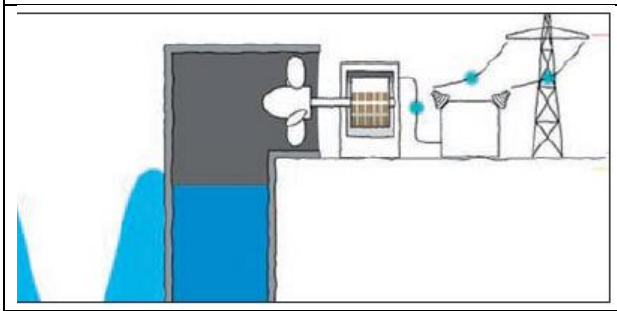
Exercise 1. Write the labels in the correct place on the diagram.

air	generator	pylons and cables	turbine
chamber	pipe	shaft	waves

Exercise 2. Match the first part of each sentence with the correct ending.

1) Waves	a) powers a generator.
2) The pipe	b) converts the energy into electricity.
3) The turbine	c) is fitted with a turbine.
4) The air	d) is connected to a shaft.
5) The turbine	e) is sucked back down the pipe when the waves leave the chamber.
6) The shaft	f) is sent via pylons and cables to homes around the country.
7) The generator	g) crash into a chamber and drive air into a pipe.
8) The electricity	h) rotates as the air is forced past it.

Exercise 3. Write sentences about the pictures, using the prompts.

	1. As waves crash … *chamber, seashore, drive, air, pipe, top, chamber*
	2. The pipe is fitted with a turbine … *rotate, air, force, past*
	3. As the waves leave the chamber … *air, suck, pipe, keep, turbine, move*
	4. The turbine is connected to a shaft which … *power, generator, convert, energy, electricity*
	5. Electricity is sent … *pylon, cable, home, country*

UNIT 5
SOLAR ENERGY

Let's warm up!
Discuss the following questions in pairs.

- What do you know about solar energy and how it works?
- Why do you think people are interested in using solar energy today?
- Have you ever thought about using solar energy in your own life?
- What challenges can we face when trying to use more solar energy?

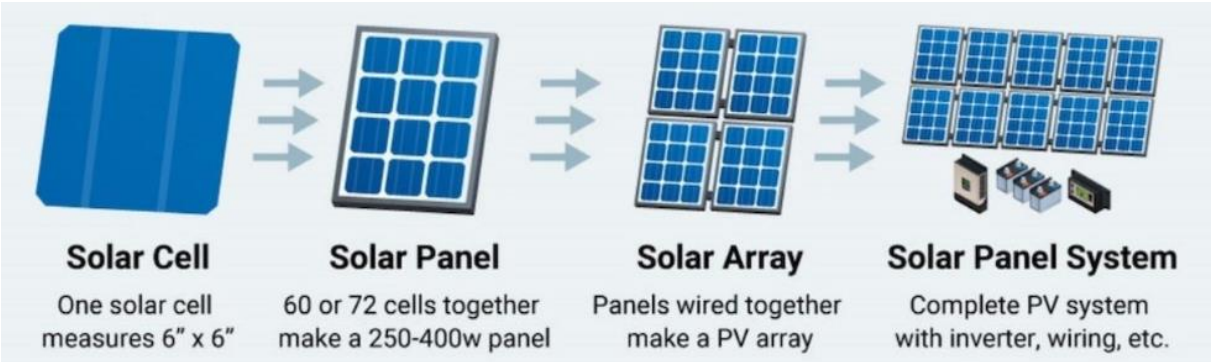
Let's read!
Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully and learn more about different ways of harnessing solar energy.

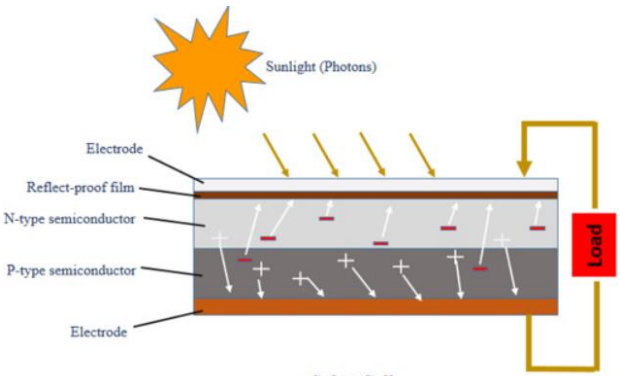
All life on Earth is fundamentally dependent on energy emitted by the Sun. Thanks to solar energy, the process of photosynthesis is carried out. Besides, the Sun gives warmth to plants and animals, which is necessary for their life. The Sun causes the water on the Earth's surface to evaporate, resulting in clouds that eventually provide fresh rainwater.

Although the surface temperature of the Sun is about 5,700 °C, the intensity of solar energy on the Earth's surface is relatively low. This is due to the significant distance from the Sun to the Earth, as well as the fact that some of the radiation is absorbed by the Earth's atmosphere. Moreover, the amount of solar energy reaching the Earth's surface depends on the weather and climatic conditions of a particular geographical area.

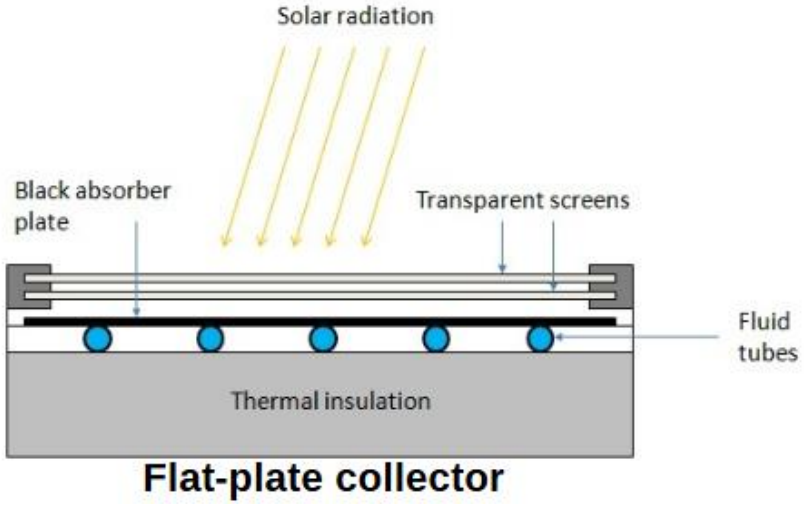
Nevertheless, if harnessed effectively, this abundant and diffused energy source could satisfy all future energy needs. Nowadays solar electricity systems use direct and indirect methods of harnessing the energy of the Sun.



Direct methods use photovoltaics (PVs), commonly known as solar cells. When light strikes the junction between a metal and a semiconductor (for example, silicon) or between two different semiconductors, a small electric voltage is generated. Typically, a single photovoltaic cell produces only about two watts of power. However, by connecting numerous individual cells together in solar-panel arrays, it is possible to generate hundreds or even thousands of kilowatts of electricity. Such systems have been used for water pumps and communication systems in remote locations, as well as for weather and communication satellites. The main disadvantage of solar cells is their dependence on the time of day and seasonal changes.



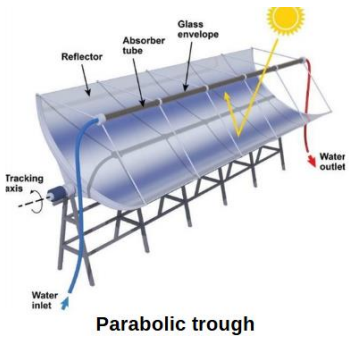
Solar Cell



Flat-plate collector

Indirect methods involve the accumulation of solar radiation in order to use for heating or boiling certain liquids, powering turbines and eventually producing electricity. For this purpose different solar collectors are used.

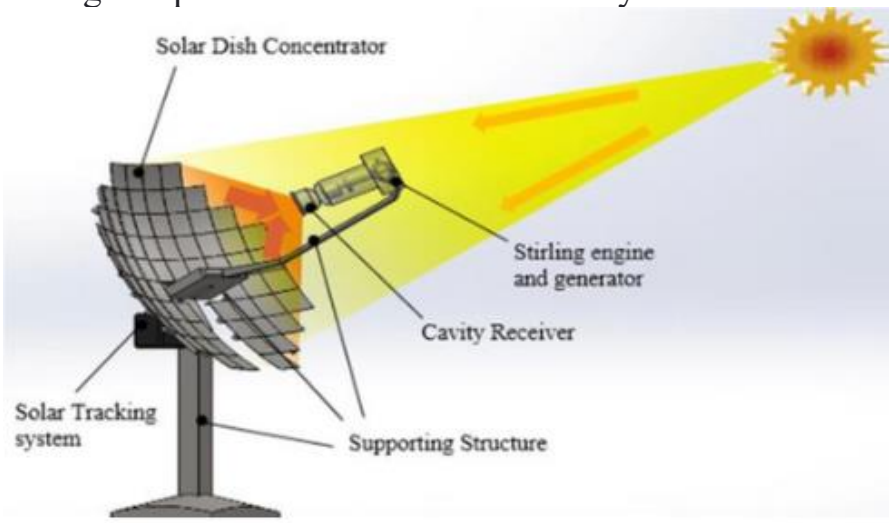
The most prevalent type of solar collector is the flat-plate collector, which comprises a dark metal plate covered by one or two sheets of glass. Glass allows sunlight to enter while reducing heat loss through convection and radiation. A dark metal plate is typically made of materials with high thermal conductivity (like copper or aluminum) and has a special coating to absorb more sunlight. This plate absorbs sunlight and converts it into heat. Under the plate, there are pipes where a liquid, usually water, flows. This liquid gets heated by the plate and can be used for applications such as domestic hot water heating, space heating, and even swimming pool heating.



Parabolic trough

A type of solar thermal collector used for harnessing solar energy and generating electricity on a

large scale is a parabolic trough. It consists of long, curved mirrors shaped like a parabola, which focus sunlight onto an absorber tube (receiver tube). The tube is filled with a special liquid, usually molten salt (40% potassium nitrate, 60% sodium nitrate), that gets hot from the focused sunlight. This hot working liquid goes through a heat exchanger to make steam from water. The steam can drive a turbine connected to a generator, converting thermal energy into electricity. Parabolic troughs are usually equipped with a tracking system that allows them to follow the sun's movement across the sky throughout the day. This maximizes the amount of sunlight captured and enhances efficiency.



Stirling solar dish

The Stirling solar dish is a type of solar energy technology that combines a parabolic dish collector with a Stirling engine to convert solar energy into mechanical power, which can then be used to generate electricity. Using a tracking system, the dish follows the position of the Sun across the sky to ensure that sunlight is continuously focused on the receiver. The Stirling engine operates on the principle of cyclic compression and expansion of a gas (usually helium or hydrogen) that transfers heat from the receiver. The heat causes the gas to expand, pushing a piston and generating mechanical work. Then this mechanical power is converted into electrical energy by a generator. Stirling solar dishes can be deployed individually or in arrays, making them suitable for both small-scale and large-scale applications.

As we strive for energy independence and sustainability, harnessing solar energy is essential for ensuring a reliable and clean energy future. By investing in solar technologies and infrastructure, we can pave the way for a more sustainable energy system that decreases our reliance on fossil fuels, preserves natural resources, and promotes a healthier planet for future generations.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) solar-panel	a) sunlight	спутник связи
2) communication	b) efficiency	изогнутое зеркало
3) heat	c) system	крупномасштабное применение
4) weather	d) mirror	расплавленная соль
5) molten	e) arrays	удалённое местоположение
6) large-scale	f) trough	излучать солнечный свет
7) remote	g) radiation	рассеянное излучение
8) parabolic	h) conditions	устойчивая энергетика
9) tracking	i) power	Теплообменник
10) sustainable	j) exchanger	система отслеживания
11) to emit	k) application	улучшать производительность
12) curved	l) satellite	солнечные батареи
13) diffused	m) location	параболический жёлоб
14) to enhance	n) salt	погодные условия

Exercise 4. Match each word to its synonym.

1) to absorb	a) to exploit
2) to harness	b) plentiful
3) significant	c) widespread
4) to comprise	d) to capture
5) prevalent	e) to transform
6) accumulation	f) essential
7) to convert	g) to save
8) abundant	h) to include
9) to enhance	i) to improve
10) to preserve	j) storage

Exercise 5. Match the word to its definition.

1) coating	a) a machine that converts fluid motion, typically from steam, water, or air, into mechanical energy through rotational movement
2) to emit	b) the process by which green plants and some organisms convert sunlight into chemical energy using carbon dioxide and water.
3) turbine	c) a cylindrical component that moves up and down within a cylinder, converting pressure into mechanical work in engines or pumps
4) piston	d) situated far away in distance

5) semiconductor	e) to change from a liquid state to a vapor, often due to an increase in temperature or decrease in pressure
6) remote	f) the act of increasing in size, volume, or quantity, often resulting from heating or other external influences
7) diffused	g) a material that can conduct electricity under certain conditions
8) photosynthesis	h) a layer applied to a surface for protection, decoration, or enhancement of properties, such as durability or appearance
9) expansion	i) spread out over a wide area
10) to evaporate	j) to release a substance, such as light, heat, or gas, into the surrounding environment

Exercise 6. Translate the following compound word combinations into Russian.

1. energy emitted by the Sun –
2. to carry out photosynthesis process –
3. to cause water evaporation –
4. to satisfy all future energy needs –
5. to harness weather satellite –
6. solar radiation accumulation –
7. heat loss prevention techniques –
8. domestic hot water heating –
9. future generations' well-being
10. parabolic dish collector –

Exercise 7. Complete the sentences with the words in the box.

solar collector, evaporate, tracking system, emit, photosynthesis, power, radiation, photovoltaic cell, satellites, receiver, solar energy

1. A strong, alternating current heats a resistive filament, causing it to _____ electrons.
2. Understanding _____ is important for understanding life, the development of the atmosphere on earth and possibly renewable hydrogen generation in the future.
3. The most common technology for harvesting energy from sunlight is the _____ _____ based on silicon.
4. In recent decades, technologies using _____ _____ panels have been designed to capture energy from the sun and convert it to electricity.
5. The easiest way to avoid _____ is to absorb it, like wearing a lead apron when you get an x-ray at the dentist.
6. There are solar cell arrays on _____ , where they are used to _____ the electrical systems.
7. The double _____ means viewers can watch one digital channel while recording another.

8. The results of a _____ _____ would indicate where gaps exist in the system and would provide a better sense of geographical differences in submissions to the data bank.
9. These materials readily absorb _____ _____, including the infrared portion of sunlight.
10. The rock keeps the area clean and allows any small spills to _____ rather than be absorbed into the soil.

Exercise 8. Find eighteen words related to solar energy in the puzzle. Read across, down, and diagonally

X	E	R	L	Y	A	T	S	Q	O	O	K	F	H	P	R	Q	E
S	W	F	A	V	T	T	L	T	L	A	Y	E	R	P	K	L	P
O	J	D	F	D	R	R	T	A	R	R	A	Y	E	A	J	P	S
L	H	R	M	I	I	M	O	R	R	I	K	D	C	R	S	A	A
A	A	C	O	F	C	A	I	U	A	B	K	O	E	T	G	R	T
R	X	M	H	F	E	I	T	R	G	C	Z	E	L	I	W	A	E
J	C	H	F	U	M	M	E	I	R	H	K	V	L	C	D	B	L
P	M	W	B	S	F	G	I	N	O	O	H	I	W	L	U	O	L
S	L	M	S	E	M	K	Z	T	C	N	R	E	N	E	X	L	I
J	S	N	A	D	J	J	Z	Z	A	Y	U	N	A	G	Z	I	T
Y	K	Y	Y	A	Z	R	E	C	E	I	V	E	R	T	T	C	E
I	N	Z	X	J	X	M	Y	Y	M	C	O	A	T	I	N	G	P

Exercise 9. Answer the following questions.

1. How does the Sun contribute to life on Earth?
2. Why is the intensity of solar energy on the Earth's surface relatively low compared to the Sun's surface temperature?
3. What are the main advantages of using solar energy as an energy source?
4. How do direct methods of harnessing solar energy work, and what are their limitations?
5. Explain the working principle of a flat-plate collector.
6. Describe the key features and working mechanism of a parabolic trough solar collector.
7. What are the main components and operating principle of a Stirling solar dish system?

Exercise 10. Choose the title for the text that fits best.

- Photovoltaic Cells and Their Impact on Global Communication Systems
- Solar Energy: Technologies and Future Potential
- The Sun's Heat: A Comprehensive Guide to Thermal Processes

Let's listen and watch!

Exercise 1. Watch the video and match the following words and word combinations with their Russian equivalents.

1) to intercept	a) связь, соединение
2) layer	b) отражать
3) bond	c) *(зд.)* выбивать
4) to wander	d) зажимать
5) tiny particles	e) перехватывать
6) to knock	f) блуждать, бродить
7) metal fingers	g) мельчайшие частицы
8) to be reliant on smth	h) *(зд.)* притягивать
9) to draw	i) пласт, слой
10) to reflect	j) полагаться на что-либо
11) dislodged electrons	k) металлические штыри
12) to sandwich	l) плавучие солнечные фермы
13) floating solar farms	m) *(зд.)* объединить
14) to string	n) смещенные электроны

Exercise 2. Watch the video again and say whether the following statements are true or false. Correct the false statements.

1. The Earth receives a significant amount of solar energy, much more than what is currently used by its population.
2. Solar panels are primarily made from a material called copper.
3. The process of converting solar energy into electricity involves the movement of electrons in silicon cells.
4. Solar energy is consistently available throughout the day, regardless of weather conditions.
5. The most efficient solar cells can convert a large percentage of sunlight into electricity.
6. Many people in developing countries lack access to reliable electricity, making solar energy a safer option.
7. According to the video solar energy can completely replace all other energy sources immediately.

Exercise 3. Answer the following questions in pairs.

1. How much solar power does the Earth intercept?
2. What are the main components of a solar cell?
3. How do solar cells generate electricity from sunlight?
4. What are some of the challenges in relying completely on solar energy?
5. How efficient are solar cells currently available?

6. What are some potential solutions to the challenges of relying on solar energy?
7. Where is solar energy already a more viable option compared to traditional electricity sources?

Let's speak!

Read these opinions. Which one do you agree with the most and why? Work in pairs and exchange your thoughts.

Let's write!

What do you think about the prospects for the development of solar energy in Belarus? Express your point of view in an Opinion Essay. Write 200-250 words.

Structure:

1. Introduction (indicate the issue to be considered, as well as your position on it).
2. Main part (point out opinions that are opposed to yours, explain why they have a right to exist, and also provide arguments in favor of your opinion).
3. Conclusion (express your point of view in other words).

Useful phrases:

- to my mind…
- in my opinion / view…
- I firmly believe…
- I am (not) convinced that…
- I (definitely) feel / think that…
- it seems / appears to me…

UNIT 6
WIND ENERGY

Let's warm up!

Read the following quote and say if you share the point of view expressed in it or not.

"Solar power, wind power, the way forward is to collaborate with nature - it's the only way we are going to get to the other end of the 21st century" (Björk)

Let's read!

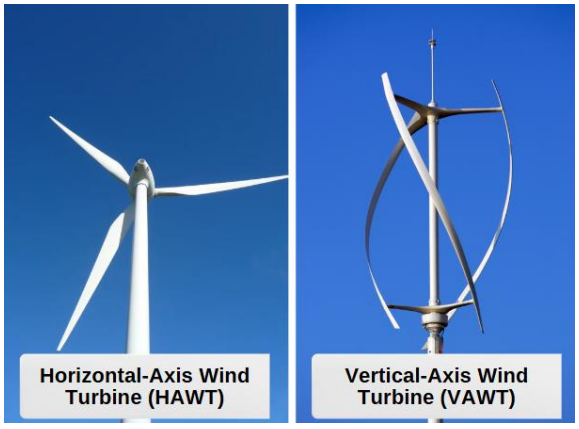
Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully and learn more about different ways of harnessing wind energy.

For millennia, humanity has understood the remarkable potential of harnessing the wind. From ancient mariners who relied on its force to propel their ships across vast oceans, to farmers using windmills to pump water and grind grain, the ability to capture and utilize this natural resource has been a cornerstone of innovation and progress. The ingenuity of our ancestors laid the groundwork for what would eventually evolve into modern wind power.

Wind is the movement of air caused by differences in air pressure in the atmosphere, which result from the uneven heating of the Earth's surface by the Sun. Because the Earth's surface is irregular and tilted, different areas heat up at different rates. When warm air rises, it creates a pressure imbalance, causing cooler air to rush in to fill the space. That's the wind!

Generating wind energy is all about kinetic energy, also known as the energy of motion. A wind turbine takes the kinetic energy of wind and turns it into electrical energy. The most common type of turbine used today are horizontal-axis wind turbines, which have two to three long, flat propeller blades that face the direction of the wind. Less common are vertical-axis wind turbines, which have blades that look like the beaters in a mixer and don't have to face the wind to capture energy. This latter type is not as efficient at producing electricity.



Each wind turbine has a set of propeller blades on a rotor at the top of the turbine tower. The rotor is covered by a nacelle, which contains a shaft and generator. The wind spins the blades, which also drives the rotor, which then

turns the shaft, which runs the generator. The electricity produced by the generator flows down the turbine tower and through a transformer to be converted to the right voltage to be transmitted to our power grid. The bigger the wind turbine, the more energy it can produce. Turbines are also tall because wind blows more consistently and faces less resistance higher up in the air.

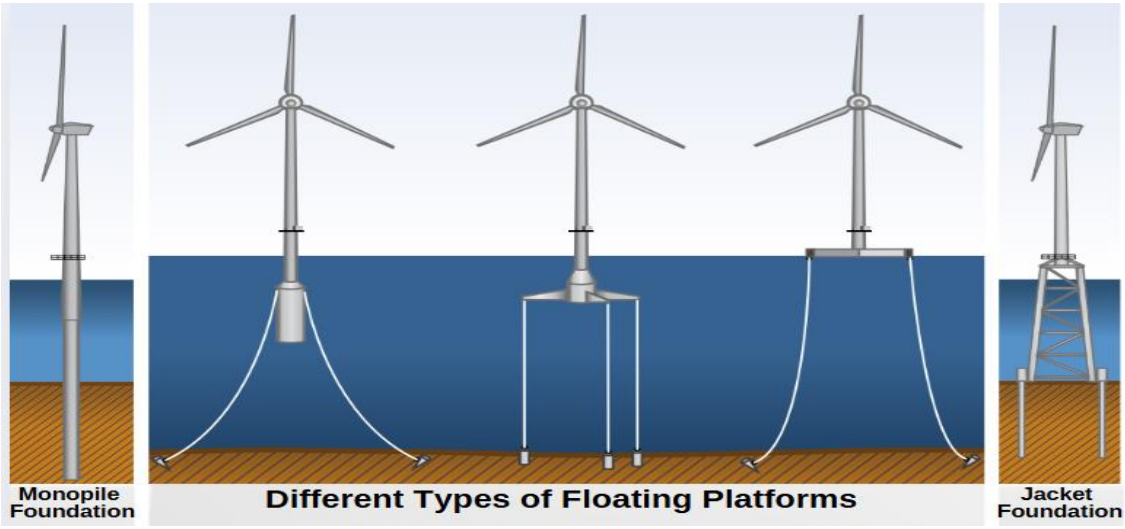
Other important parts of a turbine are the anemometer and the controller. The former measures wind speed and sends this information to the controller. The latter turns the turbine on when the wind reaches 7–11 miles per hour and turns it off if the wind gets too strong, around 55 miles per hour, to prevent damage to the blades.

Wind farms – essentially, groups of wind turbines – are often located on agricultural lands and in rural areas. Most are owned by independent power producers that sell the electricity to utilities and consumers. There are three major types of wind farms:

1) Land-based wind farms consist of multiple wind turbines strategically placed in open areas, such as plains, hills, or coastal regions, where wind resources are abundant. Land-based wind farms are expanding rapidly worldwide, with countries like the United States, China, and Germany leading in installed capacity.

2) Near shore wind farms are installations that harness wind energy located in shallow waters close to the coastline. These farms are designed to capture the benefits of offshore wind resources while minimizing some of the logistical and environmental challenges associated with deeper offshore installations.

3) Offshore wind farms are large-scale installations that harness wind energy in bodies of water, typically located several miles from the coast. Offshore turbines are anchored using various foundation types, including: Monopolies (large cylindrical structures driven into the seabed, suitable for shallow waters); Jacket Foundations (a lattice-like structure providing stability in deeper waters); Floating Platforms (designed for deep-water installations, these platforms allow turbines to be anchored to the seabed with mooring lines), etc.



Different Types of Floating Platforms

In conclusion, wind energy stands as a pivotal force in the global shift towards sustainable and renewable energy sources. Its ability to harness natural wind currents for electricity generation offers a clean, efficient, and increasingly cost-effective alternative to fossil fuels. With advancements in technology, such as larger turbines and floating wind farms, the potential for wind energy continues to expand, unlocking new opportunities in both onshore and offshore environments.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) to grind	a) region	наклонная поверхность
2) tilted	b) energy	прибрежный район
3) shallow	c) damage	поглощать энергию
4) pressure	d) grid	измельчать зерно
5) uneven	e) capacity	ключевая сила
6) coastal	f) imbalance	неравномерный нагрев
7) to capture	g) current	водоём
8) body	h) water	турбинная башня
9) pivotal	i) surface	мелководье
10) turbine	j) grain	дисбаланс давления
11) to prevent	k) heating	предотвратить повреждение
12) installed	l) tower	установленная мощность
13) power	m) force	поток ветра
14) wind	n) of water	электрическая сеть

Exercise 4. Match each word to its synonym.

1) vast	a) stable
2) ingenuity	b) constantly
3) to evolve	c) basis
4) consistently	d) quickly
5) abundant	e) huge
6) to spin	f) to use
7) to harness	g) to develop
8) cornerstone	h) plentiful
9) rapidly	i) profit
10) sustainable	j) to rotate
11) benefit	k) creativity

Exercise 5. Match the following words and word combinations to their definitions.

1) anemometer	a) a housing that contains machinery, such as engines or generators, usually located above the rotor in wind turbines
2) blade	b) to keep a boat from moving by dropping a heavy metal object attached to it by a chain into the water so that it rests on the bottom
3) plain	c) something of great importance that everything else depends on
4) nacelle	d) a flat, elongated component designed for cutting or moving through air or water, commonly found on fans or turbines
5) rotor	e) a device that changes the voltage or other characteristic of electrical energy as it moves from one circuit to another
6) to anchor	f) the bottom surface of a body of water where plants and animals live
7) ancestor	g) a person related to you who lived a long time ago
8) windmill	h) a spinning part of a machine that helps create movement, often found in helicopters or wind turbines
9) seabed	i) a large area of flat land with few trees, often used for farming
10) kinetic energy	j) a structure that converts wind energy into mechanical power used to grind grain
11) cornerstone	k) the energy possessed by an object due to its motion, dependent on both mass and velocity
12) transformer	l) an instrument used to measure the speed of the wind

Exercise 6. Translate the following compound word combinations into Russian.

1. horizontal-axis wind turbines –
2. independent power producers –
3. near shore wind farms –
4. lattice-like structure –
5. ancestors' ingenuity and creativity –
6. offshore wind farms –
7. long flat propeller blade –
8. wind turbine nacelle –
9. air pressure difference –
10. land-based wind farms –
11. to face the wind direction –
12. vertical-axis wind turbines –
13. to heat up at different rates –
14. floating wind farms –

Exercise 7. Complete the sentences with the words in the box.

wind farm, propel, axis, seabed, wind turbine, nacelle, power grid, shallow, installed capacity, windmill, cornerstone, harmful

1. Typically, the power used to _____ the water is derived from steam heat, which is turn generated by burning natural gas.
2. The Dutch _____ of the 17th century was kept facing the wind by the action of an auxiliary vane that moved the entire upper part of the mill.
3. If the _____ is not laid properly, a building will not stand properly.
4. In the USA, 400 dead bats were recorded from one _____ _____ which comprised 44 turbines.
5. To ensure the generators can work in the most efficient way, electric motors actively turn the _____ and the rotor towards the wind.
6. One _____ _____ can supply the electricity needs of more than 650 homes and cuts the amount of _____ greenhouse gases in the environment.
7. Of particular importance are changes in the tilt of the Earth's _____ , which affect the intensity of seasons.
8. The continental shelf is a relatively _____ area of _____ over which a great deal of marine life is found.
9. Such vehicles will plug in directly to the _____ _____ using standard home outlets and public charge spots.
10. With about a gigawatt of _____ _____ , Britain already has more turbines around its coasts than any other country.

Exercise 8. Work in pairs and say whether the following statements are true or false. Correct the false ones.

1. The text indicates that wind energy has been a significant factor in technological advancement throughout history.
2. Vertical-axis wind turbines are described as being more efficient than horizontal-axis turbines in generating electricity.
3. The author explains that wind is created by the uneven heating of the Earth's surface by the Sun.
4. Wind farms are primarily located in urban areas to maximize energy production.
5. The text states that larger wind turbines can produce more energy than smaller ones.
6. The anemometer is responsible for turning the turbine on and off based on wind conditions.
7. Offshore wind farms are typically situated very close to the coastline to avoid logistical challenges.

Exercise 9. Find twenty words related to wind energy in the puzzle. Read across, down, and diagonally.

Exercise 10. Answer the following questions in pairs.

1. What are some historical examples of harnessing wind power?
2. What causes wind, and how does it relate to the uneven heating of the Earth's surface?
3. How do horizontal-axis and vertical-axis wind turbines differ in their design and efficiency?
4. What are the key components of a wind turbine, and how do they work together to generate electricity?
5. What factors determine when a wind turbine is turned on and off?
6. What are the different types of wind farms, and where are they typically located?
7. How has the advancement of wind energy technology expanded its potential for electricity generation?

Let's listen and watch!

Exercise 1. Watch the video and match the following words and word-combinations with their Russian equivalents.

1) in action	a) изящный
2) sailboat	b) причина
3) sleek	c) иметь смысл
4) to cause	d) в действии, на практике
5) greenhouse gas	e) сократить
6) transmission line	f) заставлять
7) spot	g) парниковый газ
8) energy demand	h) парусник
9) reason	i) линия электропередач
10) to get off the ground	j) спрос на энергию
11) to slash	k) место
12) to make sense	l) сдвинуться с мертвой точки

Exercise 2. Watch the video again and say whether the following statements are true or false. Correct the false statements.

1. Wind turbines have only one large blade that catches the wind and spins a generator.
2. The pressure difference on each side of the turbine blades is what causes them to rotate.
3. Wind farms are considered environmentally friendly because they don't produce harmful emissions.
4. Electricity generated by wind power can currently be stored cheaply and efficiently.
5. The best locations for wind farms are often far away from the areas with the highest electricity demand.
6. Even though wind energy is free, the infrastructure required to use it can be very costly.
7. Wind turbines can only generate power during the daytime when the sun heats the air.
8. One of the biggest challenges with wind power is that wind patterns are unpredictable.
9. Wind farms require fewer repairs and less maintenance than fossil fuel power plants.
10. Experts believe that advancements in energy storage will make wind power more practical in the future.

Exercise 3. Answer the following questions.

1. How do modern wind turbines convert wind energy into electricity?

2. Why is the location of wind farms an important consideration?
3. How does the cost of building and operating wind farms compare to traditional fossil fuel power plants?
4. What is the current status of wind power in the United States, and what is the future outlook for its growth?
5. What technological advancements could help address the challenges of using wind power more widely?

Exercise 4. Fill in the table. Add your own ideas regarding the advantages and disadvantages of using wind energy.

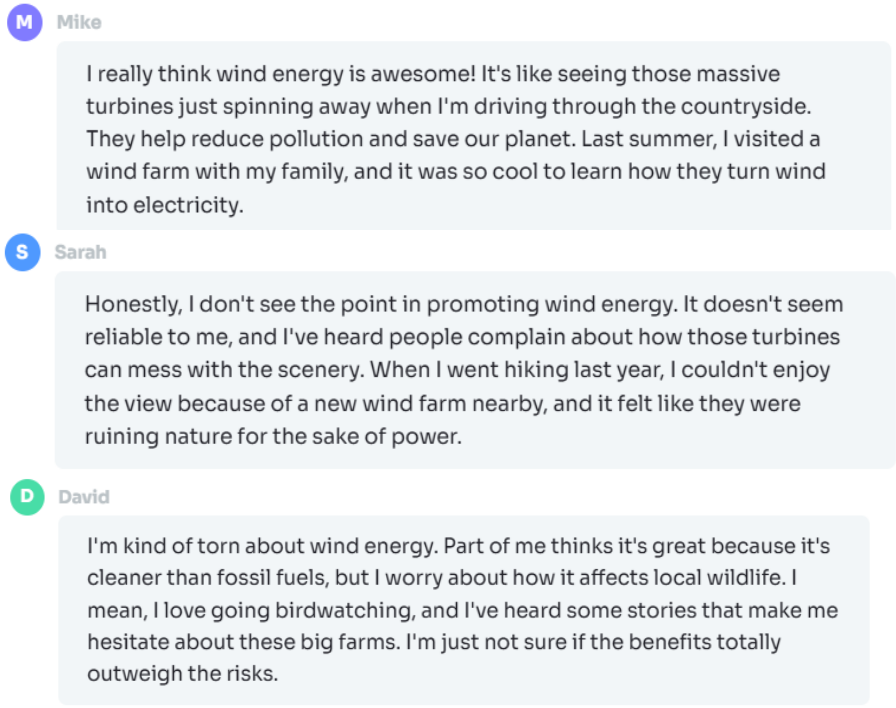
WIND ENERGY

Advantages	***Disadvantages***
1. 2. 3.	1. 2. 3.

- Compare your answers in pairs.

Let's speak!

Read these opinions. Which one do you agree with the most and why? Work in pairs and exchange your thoughts.



Let's write!

Write an informative article explaining the differences between horizontal-axis wind turbines and vertical-axis wind turbines. Discuss their advantages and disadvantages in terms of efficiency and application.

UNIT 7
NUCLEAR ENERGY

Let's warm up!

Follow the QR code and study the infographic comparing nuclear energy to fossil fuels in terms of carbon emissions and energy output. Work in small groups and discuss your initial thoughts on which energy source you believe is more sustainable and why.

Let's read!

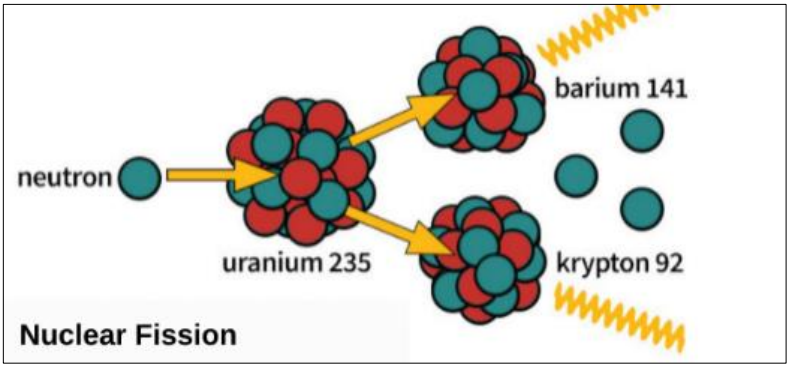
Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully and learn more about nuclear energy.

Nuclear energy is a powerful and efficient form of energy that harnesses the fundamental forces of nature to produce electricity, offering a low-carbon alternative to traditional fossil fuels. As the world seeks sustainable energy solutions to combat climate change and meet growing energy demands, nuclear energy has emerged as a significant player in the global energy landscape.

Nuclear energy is a form of energy released from the nucleus, the core of atoms, made up of protons and neutrons. This source of energy can be produced in two ways: fission – when nuclei of atoms split into several parts – or fusion – when nuclei fuse together. The nuclear energy harnessed around the world today to produce electricity is through nuclear fission, while technology to generate electricity from fusion is at the Research and Development (R&D) phase.

Nuclear fission is a reaction where the nucleus of an atom splits into two or more smaller nuclei, while releasing energy. For instance, when hit by a neutron, the nucleus of an atom of uranium-235 splits into two smaller nuclei, for example a barium nucleus and a krypton nucleus and two or three neutrons. These extra neutrons will hit other surrounding uranium-235 atoms, which will also split and generate additional neutrons in a multiplying effect, thus generating a chain reaction in a fraction of a second.



Each time the reaction occurs, there is a release of energy in the form of heat and radiation. The heat can be converted into electricity in a nuclear power plant, similarly to how heat from fossil fuels such as coal, gas and oil is used to generate electricity.

Most early atomic research focused on developing an effective weapon for use in World War II. After the war, the United States government encouraged the development of nuclear energy for peaceful civilian purposes. Congress created the Atomic Energy Commission (AEC) in 1946. The AEC authorized the construction of Experimental Breeder Reactor I at a site in Idaho. The reactor generated the first electricity from nuclear energy on December 20, 1951. A major goal of nuclear research in the mid-1950s was to show that nuclear energy could produce electricity for commercial use.

On June 27, 1954, the world's first nuclear power plant to generate electricity for a power grid started operating in Obninsk (Russia). The world's first full scale power station, Calder Hall in England opened on October 17, 1956.

At the center of a nuclear reactor is the core, which contains fuel fabricated from uranium ore. The latter is mined and processed to be eventually formed into ceramic pellets. Each ceramic pellet produces about the same amount of energy as 150 gallons of oil. These energy-rich pellets are stacked end-to-end in 12-foot fuel rods that are loaded into the reactor fuel assembly for plant operation.

Nuclear power reactors use heat produced during atomic fission to boil water and produce pressurized steam. The steam is routed through the reactor steam system to spin large turbines blades that drive magnetic generators to produce electricity.

To date, there have been five serious accidents (core damage) in the world since 1970 (one at Three Mile Island in 1979; one at Chernobyl in 1986; and three at Fukushima-Daiichi in 2011), corresponding to the beginning of the operation of generation II reactors.

The discourse surrounding nuclear power remains a contentious and evolving issue, as nations grapple with the dual imperatives of energy security and environmental sustainability. Proponents emphasize the potential of nuclear power to provide a stable, low-carbon energy source that can mitigate climate change and reduce dependence on fossil fuels. Conversely, opponents raise concerns about safety, radioactive waste management, and the potential for catastrophic accidents.

In the current situation, if effective strategies are developed to minimize the negative aspects of nuclear energy – such as enhancing safety standards, improving waste disposal methods, and building public trust – nuclear energy could play a key role in a sustainable energy future. Thus, a balanced approach that incorporates robust risk management and transparent dialogue may pave the way for a more favorable perception of nuclear energy in global energy strategies.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) energy	a) parts	экологическая устойчивость
2) chain	b) steam	разделяться на части
3) waste	c) fission	полномасштабная электростанция
4) in a fraction of	d) pellet	расщепление атома
5) to split into	e) sustainability	за долю секунды
6) effective	f) ore	керамическая гранула
7) civilian	g) demand	цепная реакция
8) low-carbon	h) rod	повреждение ядра
9) full-scale	i) damage	топливный стержень
10) uranium	j) weapon	пар под давлением
11) ceramic	k) power plant	низкоуглеродистый источник
12) fuel	l) source	действенное оружие
13) atomic	m) purposes	урановая руда
14) pressurized	n) disposal	энергопотребление
15) environmental	o) a second	гражданские цели
16) core	p) reaction	утилизация отходов

Exercise 4. Match each word to its synonym.

1) to seek	a) sequence
2) to split	b) to resist
3) to fabricate	c) to stimulate
4) contentious	d) to develop
5) chain	e) to divide
6) to incorporate	f) building
7) to emphasize	g) concern
8) to encourage	h) to transform
9) to combat	i) to extract
10) issue	j) to include
11) to evolve	k) to accent
12) construction	l) to produce
13) to convert	m) disputable
14) to mine	n) to search

Exercise 5. Match each word to its antonym.

1) public	a) traditional
2) to release	b) to disappear
3) peaceful	c) danger
4) to boil	d) to increase
5) to reduce	e) private
6) safety	f) fusion
7) to emerge	g) to freeze
8) fission	h) violent
9) to enhance	i) to degrade
10) alternative	j) to capture

Exercise 6. Match the following words and word combinations to their definitions.

1) nuclear energy	a) a system of electrical lines and equipment that delivers electricity from producers to consumers
2) accident	b) the central part of an atom that contains protons and neutrons, acting as its core
3) nucleus	c) power that comes from splitting or combining atoms, which can be used to generate electricity
4) ceramic pellet	d) energy that travels through space in the form of waves or particles, which can be emitted by certain materials
5) to harness	e) to control and make use of something for a specific purpose, often related to energy or resources
6) power grid	f) the process of splitting a large atomic nucleus into smaller parts, releasing energy in the process
7) fusion	g) the joining of two small atomic nuclei to form a larger one, also producing a significant amount of energy
8) fission	h) to arrange items on top of each other in a neat pile or formation
9) radiation	i) a small, round object made from uranium ore, clay or other materials that has been hardened by heat, often used in nuclear reactors
10) to stack	j) an unexpected event that causes damage or injury, usually happening suddenly and without warning

Exercise 7. Translate the following compound word combinations into Russian.

1. sustainable energy solutions –
2. radioactive waste management –
3. Research and Development (R&D) phase –
4. nuclear power plant –
5. reactor fuel assembly –
6. full-scale power station –
7. low-carbon energy source –
8. global energy landscape –
9. waste disposal methods –
10. robust risk management –

Exercise 8. Complete the sentences with the words in the box.

chain reaction, fusion, fuel rod, core damage, waste disposal, nuclear energy, pellet, uranium ore, nucleus, fission, radiant

1. The health physicist is a key figure in making the _____ _____ industry one of the safest in the world.
2. The _____ of a single gram of uranium is the energy equivalent of burning three tons of coal, or 600 gallons of fuel oil.
3. Electrons produce a small magnetic field as they spin and orbit the _____ of an atom.
4. When high concentrations of these pollutants accumulate and interact with sunlight, a _____ _____ occurs.
5. The process of uranium enrichment is incredibly difficult and energy intensive. Thousands of tons of _____ _____ should be processed into powder form called yellowcake.
6. However, if such an unlikely event took place and no heat sink could be restarted, _____ _____ would occur.
7. In the Sun, the process of thermonuclear _____ converts atoms of hydrogen into helium atoms, producing _____ energy.
8. However, what is crystal clear is that many of the residents do not want to have a nuclear _____ _____ facility in their region.
9. A typical _____ _____ assembly has roughly 380 pounds of uranium.
10. This generator is a small _____ of polonium and beryllium, separated by foil within the fissionable fuel core.

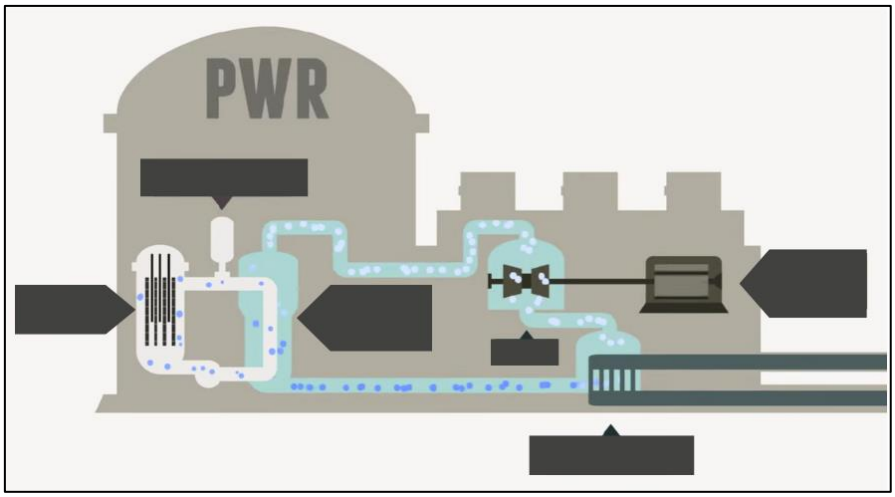
Exercise 9. Complete the following sentences using information from the text.

1. Nuclear energy is a form of energy…
2. Nuclear fission is a reaction…
3. The first reactor generated electricity from nuclear energy was…
4. The core is a part of a nuclear reactor which…
5. Each ceramic pellet produces…
6. The principle of operation of nuclear power reactor lies in…
7. Since 1970, there have been such serious accidents involving reactor damage as…
8. Proponents of nuclear energy consider this type of energy as…
9. The dangers associated with nuclear energy for humans and the environment include…
10. Effective strategies developed to minimize the negative aspects of nuclear energy are…

Exercise 10. Think of the questions to which sentences from ex.9 could serve as answers.

Let's listen and watch!

Exercise 1. Watch the video and write the names of the parts of the nuclear power plant. Explain how it works.



Exercise 2. Watch the video again and fill in the table. Add your own ideas regarding the benefits and risks of using nuclear fuels. Work in pairs and discuss what other measures can be taken in order to prevent nuclear accidents.

NUCLEAR ENERGY

Benefits	*Risks*	*Risk mitigation measures*
1. 2. 3.	1. 2. 3.	1. 2. 3.

- Is using nuclear energy a risk or an opportunity? Express your point of view.

Let's speak!

Read these facts about nuclear energy. Choose the 3 facts that you think are the most surprised. Work in pairs and exchange your thoughts.

1. Nuclear energy provided 48% of America's carbon-free electricity in 2023, making it the largest domestic source of clean energy.
2. In 2020, 13 countries produced at least one-quarter of their total electricity from nuclear, with France relying on this power source for 70% of its total electricity generation.
3. Every 18 to 24 months, reactors must shut down to allow the removal of their spent uranium fuel, which remains radioactive for thousands of years, representing a huge threat to human health in case of nuclear accidents.

4. With proper management, vigilance and safety enhancements, nuclear power plants can operate beyond their typical design lifespan of 30-40 years.
5. Though Australia has the world's largest deposits of uranium, it doesn't have any nuclear plants for electricity generation. In fact, its federal and state laws prohibit their construction.
6. One of NASA's Mars Exploration Rovers (MER), Perseverance, runs on a nuclear battery to navigate the dusty, cold planet. Other members relied on solar power to operate. However, nuclear energy is a better option than solar because there isn't enough energy coming from the sun at certain times of the Martian year.
7. Scientists in Japan recently developed a nuclear battery that can power a phone for 10 years.
8. A recent study found that modern nuclear energy produces 95% less waste than it did in the 1980s.
9. A company in Canada created a nuclear-powered drone that can fly non-stop for 3 months.
10. A new type of nuclear reactor, called the "Crystal Core," can run for 50 years without refueling.

Let's write!

Write a review of a documentary you watched about nuclear power. Use the tips below. Write 600-800 words.

Writing a Documentary Review

Step 1. Give details of the documentary

- Title of the documentary
- Intended audience

Step 2 Explain the purpose of the documentary

- What is the purpose of the documentary?
- What is the main message the director wants to get across to the audience?

Step 3 State your prior knowledge of the subject

- Did you know anything about the subject before you watched the documentary?
- What did you expect to see?
- What questions did you have about the subject?

Step 4 Summarize the documentary

- Who / What is the subject of the documentary?
- What is the documentary about? What are the main events (if any)?
- Where was it filmed?

Step 5 Give personal comments and recommendation

- Which part of the documentary do you like most?
- What have you learned from it?
- Was there anything that surprised you?

- What are the drawbacks of the documentary?
- Would you recommend this documentary to your friends

A Checklist Of Dos & Don'ts

Do

- Use the proper format: title, author, date/publication, introduction, body/summary, and conclusion
- Give evidence supporting your critical analysis and arguments
- Use quotes, specific scenes, excerpts, and facts as evidence
- Use concise and simple words
- Write in short paragraphs
- Use a formal tone
- Write in second and third person point of view
- Use simple and compound sentences so your audience can easily comprehend your writing
- Do have a catchy but profound conclusion

Don't

- Use too many passive sentences
- Contradict yourself
- Use slang or jargon
- Use large blocks of text
- Write extremely long reviews

UNIT 8
GEOTHERMAL ENERGY

Let's warm up!

Discuss the following questions in pairs.

- What do you know about geothermal energy and how it works?
- Do you think renewable energy sources like geothermal are important for the environment?
- Why do you think some people might be against using geothermal energy?
- How does your country use or plan to use geothermal energy in the future?

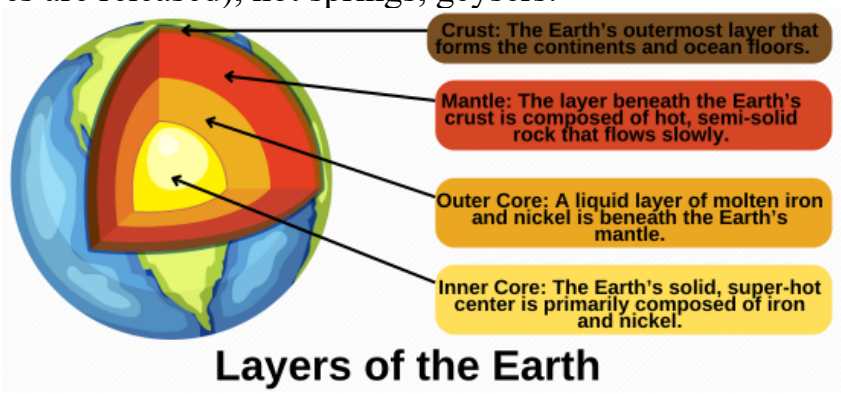
Let's read!

Exercise 1. Follow the QR code to learn the words:

Exercise 2. Read the text carefully and learn more about different ways of harnessing geothermal energy.

Geothermal energy is heat within the Earth. The word geothermal comes from the Greek words *geo* (Earth) and *therme* (heat). Geothermal energy is a renewable energy source because heat is continuously produced inside the Earth. People use geothermal heat for bathing, to heat buildings, and to generate electricity.

The Earth has four major parts or layers: an inner core of solid iron (1,500 miles in diameter), an outer core of hot molten rock called magma (about 1,500 miles thick), a mantle of magma and rock surrounding the outer core (about 1,800 miles thick), a crust of solid rock that forms the continents and ocean floors (15 to 35 miles thick under the continents and 3 to 5 miles thick under the oceans). Scientists have discovered that the temperature of the Earth's inner core is about 10,800 degrees Fahrenheit (°F), which is as hot as the surface of the sun. The slow decay of radioactive particles in the Earth's core, a process that happens in all rocks, produces geothermal energy. The latter finds its way to the Earth's surface in three ways: volcanoes and fumaroles (holes in the Earth where volcanic gases are released), hot springs, geysers.



Layers of the Earth

Geologists use various methods to find geothermal reservoirs (naturally occurring areas of hydrothermal resources). Drilling a well and testing the temperature deep underground is the most reliable method for locating a geothermal reservoir.

Some applications of geothermal energy use the Earth's temperatures near the surface, while others require drilling miles into the Earth. There are three main types of geothermal energy systems:

1) **Direct use and district heating systems** use hot water from springs or reservoirs located near the surface of the Earth. Ancient Roman, Chinese, and Native American cultures used hot mineral springs for bathing, cooking, and heating. Today, many hot springs are still used for bathing, and many people believe the hot, mineral-rich waters have natural healing powers.

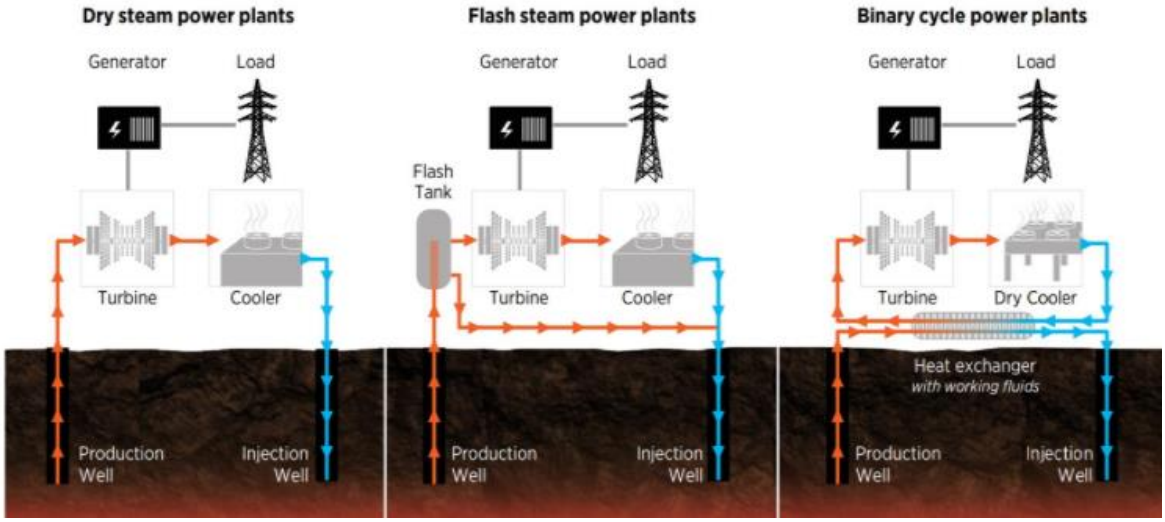
Geothermal energy is also used to heat buildings through district heating systems. Hot water near the Earth's surface is piped directly into buildings for heat. A district heating system provides heat for most of the buildings in Reykjavik, Iceland.

2) **Geothermal power plants** require high-temperature (300°F to 700°F) hydrothermal resources that come from either dry steam wells or from hot water wells. People use these resources by drilling wells into the Earth and then piping steam or hot water to the surface. The hot water or steam powers a turbine that generates electricity. Some geothermal wells are as much as two miles deep. There are three basic types of geothermal power plants:

a) Dry steam plants use steam directly from a geothermal reservoir to turn generator turbines. The first geothermal power plant was built in 1904 in Tuscany, Italy, where natural steam erupted from the Earth.

b) Flash steam plants take high-pressure hot water from deep inside the Earth and convert it to steam to drive generator turbines. When the steam cools, it condenses to water and is injected back into the ground to be used again. Most geothermal power plants are flash steam plants.

c) Binary cycle power plants transfer the heat from geothermal hot water to another liquid, called a heat transfer liquid. The heat causes the second liquid to turn to steam, which is used to drive a generator turbine.



3) **Geothermal heat pumps** use the Earth's constant temperature to heat and cool buildings. Geothermal heat pumps transfer heat from the ground (or water) into buildings during the winter and reverse the process in the summer.

In conclusion, geothermal energy presents a promising renewable energy source with several notable advantages, including its low greenhouse gas emissions, reliability, and the ability to provide a consistent energy supply regardless of weather conditions. Additionally, it can contribute to energy independence and job creation in local communities. However, challenges such as high initial investment costs, geographical limitations, and potential environmental impacts must be carefully considered. Balancing these advantages and disadvantages is essential for maximizing the potential of geothermal energy as a sustainable solution for our future energy needs.

Exercise 3. Make up the word combinations from columns A and B and find their Russian equivalents in C.

A	B	C
1) dry	a) particles	земная кора
2) ocean	b) rock	внешнее ядро
3) volcanic	c) core	сухой пар
4) solid	d) spring	океаническое дно
5) molten	e) decay	расплавленная порода
6) outer	f) steam	покров магмы
7) radioactive	g) independence	медленный распад
8) energy	h) gas	горячий источник
9) healing	i) a well	вулканический газ
10) geographical	j) powers	тепловой насос
11) magma	k) crust	бурить скважину
12) the Earth	l) iron	твердое железо
13) slow	m) pump	целебные свойства
14) hot	n) limitations	энергетическая независимость
15) to drill	o) floor	радиоактивные частицы
16) heat	p) mantle	географические ограничения

Exercise 4. Match each word to its synonym.

1) inner	a) basin
2) to discover	b) continuous
3) to transfer	c) remarkable
4) solid	d) to reveal
5) notable	e) to transmit
6) to locate	f) to transform
7) constant	g) to place
8) reservoir	h) significant
9) essential	i) internal
10) to convert	j) strong

Exercise 5. Match the following words and word combinations to their definitions.

1) hot spring	a) a machine that converts fluid motion, like water or steam, into mechanical energy
2) inner core	b) to change from a gas to a liquid state, often due to cooling
3) to condense	c) to create a deep hole in the ground to access water or other resources
4) turbine	d) hot liquid rock found just below the surface of the Earth
5) geothermal reservoir	e) a natural pool of water that is heated by geothermal energy from underground
6) fumarole	f) an opening in the ground that releases steam and gases from volcanic activity
7) magma	g) to force a substance into something else, usually using a tool or device
8) to erupt	h) a layer of semi-solid rock located between the Earth's crust and outer core, where magma can flow
9) to drill a well	i) an underground area filled with hot water and steam that can be used for energy
10) geyser	j) a pool of hot water that sends a column of water and steam into the air on a regular or irregular schedule
11) to inject	k) to suddenly release gas, ash, and lava
12) mantle	l) the very center part of the Earth, made mostly of solid iron and nickel

Exercise 6. Translate the following compound word combinations into Russian.

1. promising renewable energy source –
2. geothermal energy systems –
3. low greenhouse gas emissions –
4. geothermal power plants –
5. heat transfer liquid –
6. radioactive particles decay –
7. dry steam well –
8. binary cycle power plant –
9. solid rock crust –
10. consistent energy supply –
11. high initial investment costs –
12. potential environmental impacts –
13. geothermal heat pumps –
14. district heating system –
15. flash steam plant –
16. geothermal hot spring features –

Exercise 7. Complete the sentences with the words in the box.

radioactive, sustainable, heat pump the earth crust, erupt, rock, healing power, decay, geothermal, magma hot spring

1. The geological composition of _____ and soil dictates the type of shore which is created.
2. The internal, or _____ , heat from within the Earth is responsible for the fact that temperature increases with depth.
3. Heavy metals are natural constituents of _____ _____ , but at high concentrations they become harmful to the environment and humans.
4. The tunnel would have to be done before the _____ started to move.
5. Radioactive elements have different isotopes that _____ at different rates.
6. Often _____ _____ waters come from great depths and are in contact with _____ minerals, which impart traces to the water.
7. Through this process, ocean circulation acts like a _____ _____ and determines our climate to a great extent.
8. The _____ _____ of water has been known since antiquity, and in Valais tourists can recover their lost energy and get back in shape in thermal springs or health spa centres.
9. Shield volcanoes tend to _____ non-explosively, mainly pouring out huge volumes of fluid lava.
10. Globalization and localization enhance the prospects for rapid and _____ growth in developing countries.

Exercise 8. Work in pairs and say whether the following statements are true or false. Correct the false ones.

1. Geothermal energy is derived from the decay of radioactive particles found in the Earth's crust.
2. The inner core of the Earth is primarily composed of solid iron and is significantly hotter than the surface of the sun.
3. Ancient civilizations utilized geothermal resources for various practical purposes, including cooking and bathing.
4. Geothermal power plants primarily rely on low-temperature hydrothermal resources to generate electricity.
5. The process of using geothermal heat pumps involves transferring heat from buildings to the ground during the winter.
6. The text indicates that geothermal energy has the potential to enhance energy independence and create job opportunities in local areas.
7. The author of the text suggests that the challenges associated with geothermal energy are insignificant and easily overcome.

Exercise 9. Find twenty words related to geothermal energy in the puzzle. Read across, down, and diagonally.

O	D	U	C	P	T	M	T	V	C	O	R	E	M	Y	I	R	Q
R	E	N	I	C	C	F	A	R	L	A	Y	E	R	R	N	A	X
N	C	W	N	R	Q	O	R	N	T	W	K	L	V	Y	J	D	L
X	A	X	N	U	G	W	N	E	T	B	W	V	O	D	E	I	B
C	Y	G	E	S	I	E	X	D	S	L	Q	S	L	V	C	O	V
L	V	T	R	T	Z	V	Y	N	E	E	E	E	C	G	T	A	N
F	U	M	A	R	O	L	E	S	N	N	R	D	A	U	I	C	Z
T	K	N	M	S	T	E	A	M	E	O	S	V	N	M	O	T	F
Y	L	V	M	X	R	O	C	K	Q	R	O	E	O	U	N	I	C
G	F	Z	O	G	D	R	I	L	L	D	W	T	I	I	K	V	D
E	S	O	L	I	D	B	U	M	A	G	M	A	B	H	R	E	X
E	V	E	R	U	P	T	I	O	N	C	P	U	M	P	J	M	N

Exercise 10. Answer the following questions in pairs.

1. What are the four major layers of the Earth?
2. How does the Earth produce geothermal energy?
3. What are the three main ways geothermal energy finds its way to the Earth's surface?
4. What is the most reliable method for locating a geothermal reservoir?
5. What are the three main types of geothermal energy systems?
6. How do geothermal power plants generate electricity?
7. What are the advantages and challenges of using geothermal energy?

<u>Let's listen and watch!</u>

Exercise 1. Watch the video and fill in the gaps in a video summary.

1. Geothermal energy harnesses the Earth's internal heat, generated by [1]_____ and [2]_____ from its formation.
2. Wells are drilled into the Earth's crust, typically between [3]_____ , to extract this heat using water and steam.
3. Hot water can be directly used for [4]_____ or converted into steam to generate [5]_____ .
4. Major geothermal development occurs in [6]_____ , despite its small share in the [7]_____ .
5. One of geothermal energy's main advantages is its [8]_____ , providing [9]_____ .

6. However, concerns include potential [10]_____ and the risk of [11]_____ if not managed properly.
7. Additionally, the [12]_____ are high due to necessary geological assessments and drilling operations.

Exercise 2. Watch the video again and make up any 3 questions to its content. After watching exchange your questions and answer them together.

Let's speak!

Work in pairs to discuss the state and prospects of geothermal energy development in the world. Put the words in the questions in the correct order and complete the dialogue below.

A: I've just read an interesting article about geothermal energy. By the way, it / what/ do you know / is?
B: If I'm not mistaken, this is …
A: You are absolutely right. major / the Earth / are/ layers / what / of / the?
B: As I know, …
A: That's right.
B: you / what / used / could / nowadays / remind / are / geothermal energy systems / me?
A: You know, there are …
B: of / geothermal power plants / are / types / there / different / aren't there?
A: Certainly, …
B: I see. I also know that the main advantages of geothermal energy include…
A: I couldn't agree more.
B: Thus, safe / of / this / absolutely / type / is / energy?
A: Not really, …
B: I got it. problems / can / be / these / solved / how?
A: I think, …
B: That makes sense. Thanks. Now I'm clear about geothermal energy development in the world.
A: It's OK.

Let's write!

Choose one of the topics below and express your point of view in an Opinion Essay. Write 200-250 words.

Topics:

1. Geothermal energy is often overlooked compared to solar and wind energy. Should we prioritize its development over other renewable sources? To what extent do you agree or disagree with this opinion?

2. The development of geothermal energy technologies is often seen as too costly and complex. Is this a positive or negative development for the future of renewable energy?
3. Many believe that investing in geothermal energy will lead to greater energy independence for nations. To what extent do you agree or disagree with this viewpoint?
4. Critics claim that geothermal energy can have detrimental effects on local ecosystems. Is this concern valid, or do the benefits outweigh the potential drawbacks?
5. The reliance on fossil fuels continues to dominate the global energy market despite the availability of renewable options like geothermal energy. Is this a positive or negative development for our planet's future?

Structure:
1. Introduction (indicate the issue to be considered, as well as your position on it).
2. Main part (point out opinions that are opposed to yours, explain why they have a right to exist, and also provide arguments in favor of your opinion).
3. Conclusion (express your point of view in other words).

Useful phrases:
- to my mind…
- in my opinion / view…
- I firmly believe…
- I am (not) convinced that…
- I (definitely) feel / think that…
- it seems / appears to me…

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