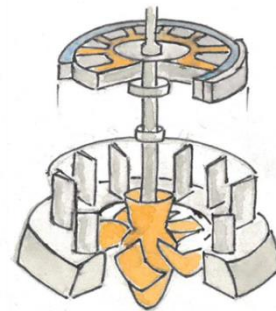
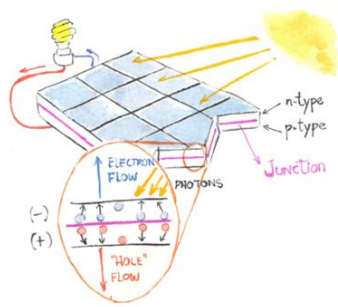
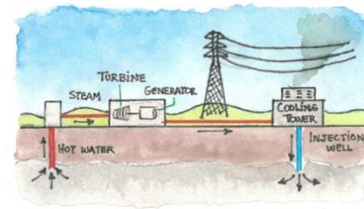
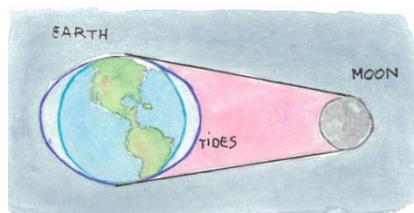


# LET'S TALK ABOUT ...



# ENERGY RESOURCES



# STUDENT' WORKSHEET

Names:		Surnames:		Group: 3rd ESO ___	Qualification
				Date:	

## LET'S TALK ABOUT... ENERGY RESOURCES

### Introductory text



An **energy resource** is something that contains energy that can be used by us. Sometimes we can achieve directly this energy, and sometimes, this energy should be transformed. We can use oil to obtain petrol for cars, so, oil is an energy resource. Electricity can be used to produce heat and light, so electricity is an energy resource too. Solar energy can be used to heat or to produce electricity, so, solar energy is an energy resource as well. In nature we have lots of energy resources such as wind, fossil fuels, nuclear energy, etc.

In this unit, we are going to learn lot of things about energy resources. Let's go!!!

### INFORMATION ABOUT ACTIVITIES:



Individual activity



Work in pairs



Work in groups of three



Work in groups of four



**Activity 1** (3 Points) Write three energy resources, different from the ones that appear in the initial text, and describe some of their uses. Follow the example:

### Grammar help:

#### DEFINING

.....	is a are	(generic term) place person thing concept entity device instrument tool etc.	where who which that	.....
-------	-------------	---------------------------------------------------------------------------------------------------------	-------------------------------	-------

#### RELATION CAUSE-EFFECT. GIVING REASONS

as a result  
because/thanks to  
consequently/so  
for example  
for instance  
that is why  
such as

**Example:** Wood can be burned to obtain heat.

- 1.
- 2.
- 3.



**Activity 2** (9 Points) Read next text, "**Energy resources classifications**", and underline with a **blue** pen **all the information** about the energy resources classification according to **the use in a country**, with a **green** pen **all the information** according to **the way to be obtained** and with a **red** pen **all the information** according to **the possibility to be re-used**. (Alternatively you can do a mind map with the different energy resources classifications)

### Energy resources classifications



There are different classifications of energy resources, but the three more used are related to the use in a country, to the way to be obtained and to the possibility to be reused. According to these classifications, we distinguish:

- **According to its use in a country:**

- Energy resources that are so used in a country are called **conventional energy resources**. (In Spain, the nuclear energy is a conventional energy resource because a lot of energy is obtained from this kind of energy).
- Energy resources that are not so used in a country are called **alternative energy resources**. (In Spain the geothermal energy is an alternative energy resource because just a small part of the energy used in Spain is obtained from this kind of energy resource).

**Important:** Hydropower is conventional in Spain (so used) but alternative in Saudi Arabia (not so used); so it depends on the use in a country.

- **For its way to be obtained:**

- Energy resources that can be used directly obtained from the nature are called **primary energy resources**. (Coal is a primary energy resource because is used directly from the nature).
- Energy resources that have to be change to be used are called **secondary energy resources**. (Petrol (fuel for cars) is a secondary energy resource because, to be used by cars, it has to be transformed).

- **For its possibility to be re-used:**

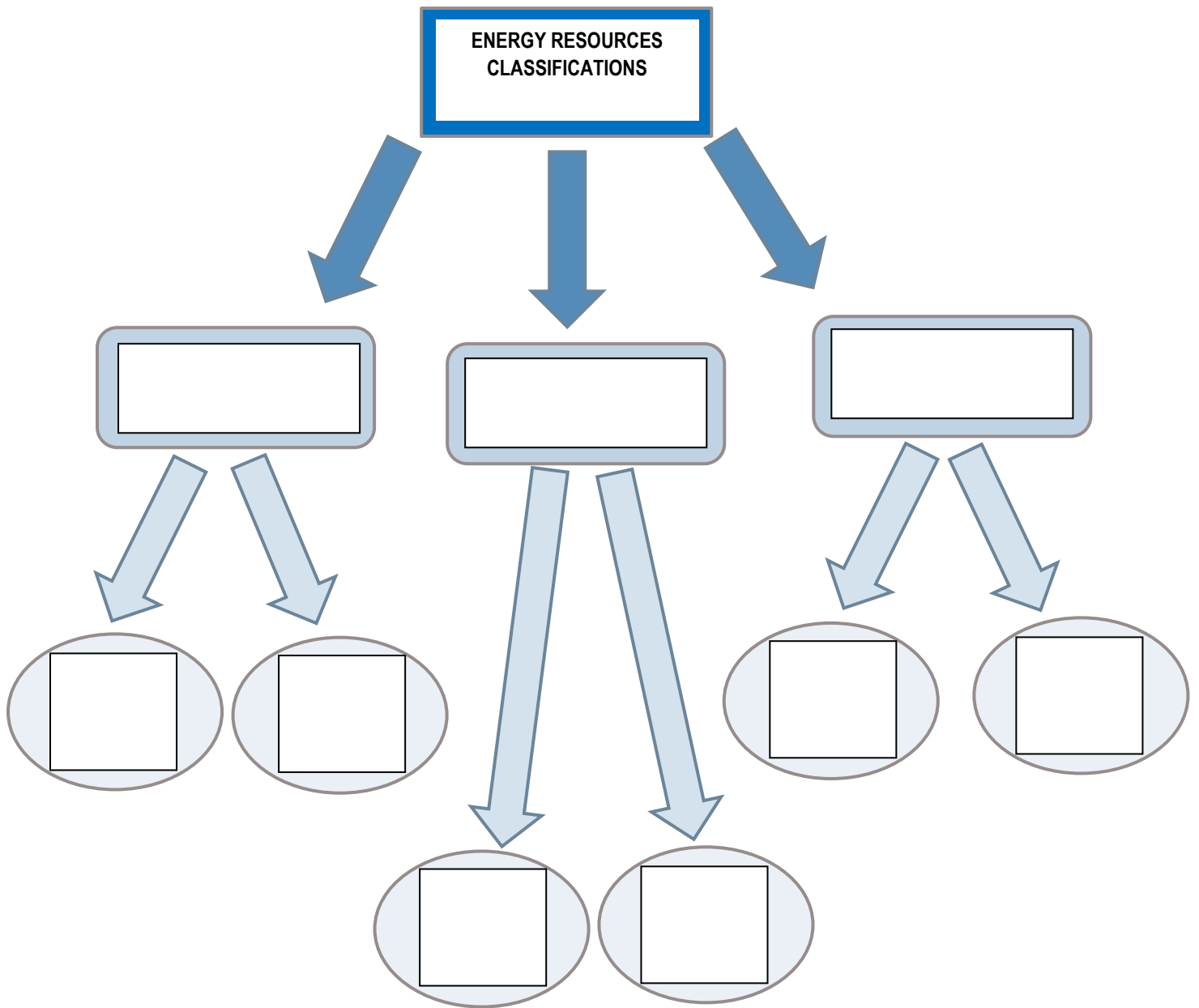
- Energy resources renovated directly by the nature (so we can use its energy forever) are called **renewable energy resources** (Sun energy is a renewable energy because it don't has finish). (Infinite)
- Energy resources that not can be renovated by the nature (so we cannot use it forever because it will finish) are called **non-renewable energy resources** (Fossil fuels are a not renewable energy resource because we will finish all the fossil fuels in overtime and it cannot be regenerated in a small period of time). (Finite).

Important is to consider that sometimes, people say that all the alternative energy resources are renewable. This is a usual mistake. Although the most of the conventional energy resources are renewable, some of them no. For example, in Spain, the use of water to obtain energy, by hydropower stations, is usual (so is conventional, not alternative), but renewable as well. Both types of energy resources make reference to different energy resources classifications.

Maybe Saudi Arabia doesn't use water to obtain electricity, so hydropower will be an alternative energy resource (and it's conventional in Spain), it depends on the use in a country.

**In this unit we are going to talk about the third energy resources classification (for its possibility to be re-used).**

MIND MAP ACTIVITY 2





**Activity 3** (45 Points) According to the energy resources classifications, put the words that appear in the box in the table, according to the use in your country. Maybe one energy resource can be classified in more than one column; put them in each possible one. **Follow the examples done:**

TABLE

ENERGY RESOURCES CLASSIFICATIONS					
For its use in a country					
		Primary			Non-renewable
Electricity*	Solar energy	Solar energy	Electricity*	Solar energy	

**WORDS**

(IMPORTANT: If you don't know the meaning of a word, ask to the teacher using the expression: "Teacher what is the meaning of ....., please?")

<u>For its use in a country</u>	Secondary	<u>Solar energy</u>	Oil	Renewable	Butane
For the way to be obtained	<u>Primary</u>	Natural gas	<u>Electricity*</u>	Conventional	Wind energy
Geothermal energy	Gasoil	Alternative	Coal	Nuclear energy	Bio fuel
For its possibility to be re-used	Sunflower oil	Hydropower	Petrol	<u>Non-renewable</u>	Wood

Electricity\* = Electricity obtained in a power station.



**Activity 4** (3 Points) Draw a picture of three energy resources that appear in activity three.

## Non-renewable energy resources

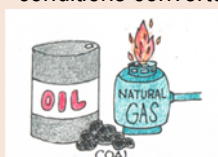
### Fossil fuels



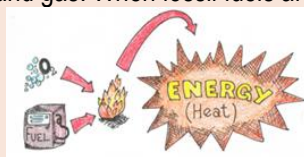
A **non-renewable energy resource** can't be renovated by the nature (or need a long period of time to be renovated). The two more non-renewable energy resources used by humans are **fossil fuels** and **nuclear energy**.

#### Fossil fuels

Plants are able to make their own food by capturing the energy from the sunlight through a process called photosynthesis. These plants are the food for some animals that are the food for other animals. Fossil fuels were formed from plants and animals that lived millions of years ago. **Coal** (a solid fossil fuel usually black) is made from the remains of plants. **Oil** (a liquid fossil fuel) and **natural gas** (a gas fossil fuel) were formed when marine organisms died and sank to the bottom of the sea; pressure, temperature and chemical conditions converted them to oil and gas. When fossil fuels are burnt the energy stored by them is released.

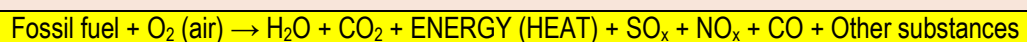


Fossil fuels.



Fossil fuels' combustion.

Fossil fuels can be used to heat, to light, to cook, to produce electricity, etc. Fossil fuel real combustion produces some gases such as CO<sub>2</sub> (increase global warming), SO<sub>x</sub> and NO<sub>x</sub> (sulphur and nitrogen oxides, that produce atmospheric pollution and acid rain), CO (lethal gas), etc.



**Watch the video** "Fractional distillation. The chemistry journey. The fuse school" in: <https://www.youtube.com/watch?v=alzTofTj7CQ>, about the fractional distillation of oil.



#### Optional activities about the video (12 Points; 2 points each question):

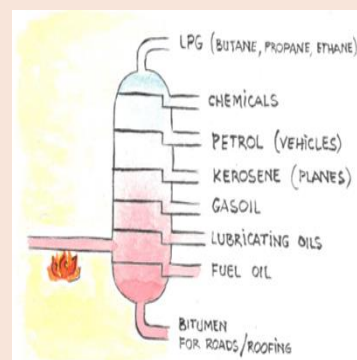
1. What is the oil fractional distillation?
2. What is a hydrocarbon?
3. What is oil?
4. Write three products obtained from the oil fractional distillation.
5. According to the video, which product obtained from the oil fractional distillation, can give us more energy?
6. Write some uses of the products obtained from the oil fractional distillation.

Oil is a mixture of different hydrocarbons (chemical compounds made up mainly of carbon and hydrogen) that can be obtained from a process called *fractional distillation* (oil is heated in order to obtain products such as asphalt, fuel, kerosene (fuel used in planes), petrol (fuel used in some cars), gasoil (fuel used in some cars), butane, propane, ethane, etc., that have a different vaporization temperature). Petrochemical companies use oil to obtain lots of products as plastics.

Coal and natural gas should be used to be burned to obtain heat.



Fire obtained by natural gas combustion



Oil fractional distillation



**Activity 5** (17 Points) After reading the text, try to answer the questions below:

- (3 P) Which are the most usual fossil fuels? \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
- (3 P) Write three uses of these fossil fuels: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
- (1 P) How were the fossil fuels formed? **Fossil fuels were formed** \_\_\_\_\_
- (2 P) Which is the main difference between the formation of coal and natural gas or oil? **Coal is made from** \_\_\_\_\_ **and natural gas and oil were formed** \_\_\_\_\_
- (3 P) What are the three causes that converted some fossil fuels in oil or natural gas? \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_
- (1 P) What happens when the coal or the natural gas are burnt? **When the coal or the natural gas are burnt** \_\_\_\_\_.
- (1 P) Which is the composition of oil? **Oil is a mixture of** \_\_\_\_\_
- (3 P) Write three products obtained from the oil fractional distillation: \_\_\_\_\_, \_\_\_\_\_ and \_\_\_\_\_

### Nuclear energy

#### Nuclear energy

All matter is made of particles called atoms. Every atom contains a nucleus which is made up of protons (+ charge) and neutrons (no electrical charge), and electrons (- charge) that are spinning around the nucleus.

Nuclei contain a vast amount of energy called nuclear energy that holds together, in a small space, protons and neutrons. Some substances are radioactive.

This means that their atoms release some of this energy as radiation. This can be dangerous to living organism (because effects of radioactivity), but can be used in many ways. There are two types of nuclear reactions: **nuclear fusion** and **nuclear fission**.



Atom

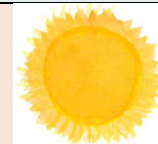
**Watch the video "Fission vs fusion. What is the difference?"** in "<https://www.youtube.com/watch?v=2W-GEE6YU4M>", about nuclear fission and fusion reactions.



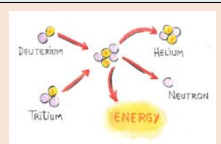
**Optional activities about the video (10 Points; 2 points each question):**

- What is a fission nuclear reaction?
- What is a fusion nuclear reaction?
- What are the usual fuels used in a fission nuclear reaction?
- What is the usual fuel used in a fusion nuclear reaction?
- What nuclear reaction produces more energy?

**Nuclear fusion** supposes to join two small nuclei to form a larger one. Nuclear fusion only takes place at extremely high temperatures and releases huge amounts of energy. It's a clean reaction (doesn't produce radioactive pollution), but is very difficult to achieve. It's the nuclear reaction produced in the Sun.



The Sun

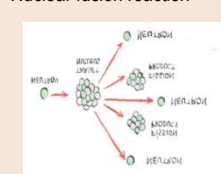


Nuclear fusion reaction

**Nuclear fission** supposes to "splitting apart" the nuclei. Nuclear fission occurs when the nucleus of an atom (like Uranium) is bombarded with neutrons. The nucleus splits open, releasing neutrons and large amounts of energy and radioactive substances. This process takes place inside nuclear reactors, in nuclear power stations (the heat produced in nuclear reaction heat water, producing steam that turn turbines connected to the generator, in which is produced the electricity), and in nuclear explosions (bombs).



Nuclear explosion



Nuclear fission reaction



**Activity 6** (5 Points) Write the correct nuclear reaction next to each picture (nuclear fission or nuclear fusion):

 <hr/>	 <hr/>	 <hr/>	 <hr/>	 <hr/>
-----------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------	-----------------------------------------------------------------------------------------	------------------------------------------------------------------------------------------	-------------------------------------------------------------------------------------------

**To know more about nuclear energy**



The **European Organization for Nuclear Research, CERN**, located between Switzerland and France, is a European research organization with the largest particles physics laboratory in the world. This organization is composed by 23 different countries (22 European and Israel). In its particle accelerators, scientists do investigations in high-energy physics research. One interesting investigation carries out by them; try to obtain a controlled nuclear fusion reaction to obtain a huge quantity of energy without producing pollution. This kind of nuclear reaction is very difficult to achieve but could represent an inexhaustible and clean energy resource for the future.



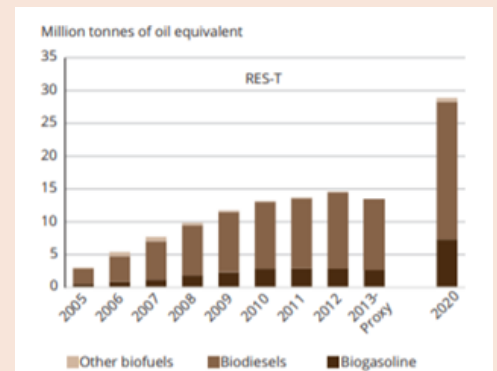
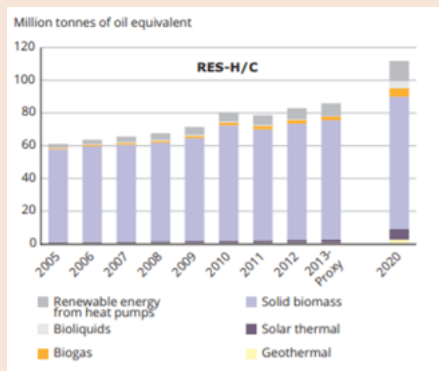
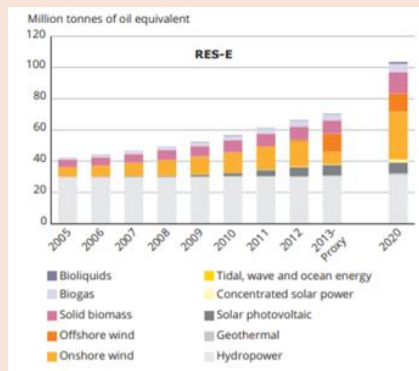
Renewable energy resources



A **renewable energy resource** can be renovated by the nature in a short period of time. There are lots of renewable energy resources but the most used by humans are **solar energy, wind energy, water energy (hydropower), wave's energy, tidal energy, geothermal energy, biofuels/biomass and the energy from waste.**

Fossil fuels are very used around the World. However, most of the European countries don't have lot of fossil fuels (they have to buy it), and fossil fuels are non-renewable energy resources. For these and for environmental reasons (fossil fuel combustion produces polluted gasses that are changing our climate and that produce some environmental problems such as the global warming, the acid rain, the chemical fog, etc., and some health problem such as respiratory problems), the European Union promotes the use of renewable energy resources. European Union has engaged in an ambitious program in which fossil fuels use should be reduced, in order to promote the renewable energy resources to achieve a self-energetic dependence and to reduce the environmental problems. In all Europe the number of "Wind Farms" and "Solar Power Stations" is increasing year by year, to achieve these goals.

Next tables, from the "European environment agency", show us the use of renewable energy resources to produce electricity (RES-E), to heating and cooling (RES\_H/C) and in transport (RES\_T), from the last ten years.

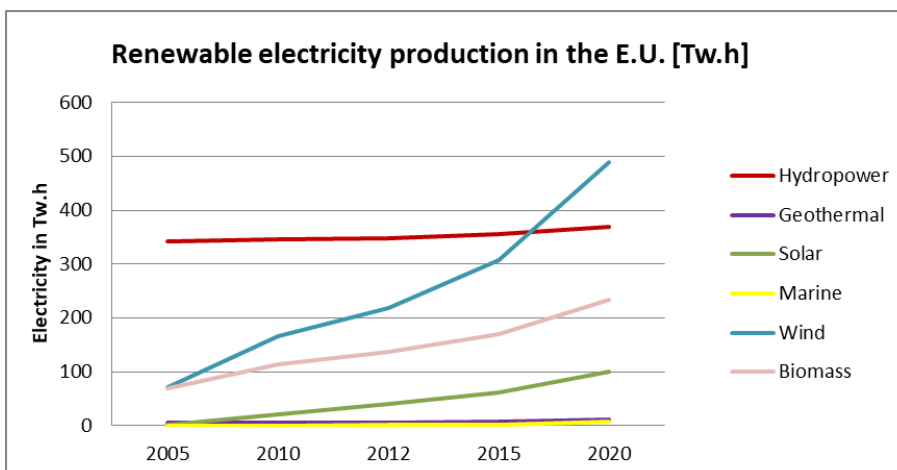


Source: EEA, 2014 (authors' work based on Eurostat 2014a and 2014b)

From: the European environment agency: [file:///C:/Users/hospi/Dropbox/Mi%20PC%20\(LAPTOP-O8S6THKT\)/Downloads/Tech%2001%202015%20Renewable%20energy%20in%20Europe%20\(2\).pdf](file:///C:/Users/hospi/Dropbox/Mi%20PC%20(LAPTOP-O8S6THKT)/Downloads/Tech%2001%202015%20Renewable%20energy%20in%20Europe%20(2).pdf)



**Activity 7 (11 Points)** Look at next graph that represents the evolution of the renewable electricity production in the E.U. (in Tw.h), during the last 15 years. After that, answer the questions:



Dates from: <https://www.sciencedirect.com/science/article/pii/S1364032115006346>

According to the graph "Renewable electricity production in the E.U.":

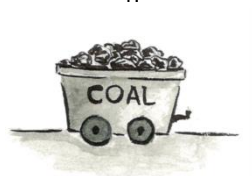
- 1) (1 Point) What renewable energy resource was the most used in 2005 to produce electricity?
- 2) (3 Points) What renewable energy resource was most used in 2020 to produce electricity? Why do you think it has changed?
- 3) (2 Points) What energy resource increases the most in the production of electricity for the last 15 years? What aspect shows you your answer from the graph?
- 4) (3 Points) Why do you think E.U. promotes the use of renewable energy resources to produce electricity? (HELP: Look at the graph and at the text "Renewable energy resources")
- 5) (2 Points) Write the two renewable energy resources more used in your country to produce electricity. (You can obtain some information on the net).



**Activity 8** (15 Points) Energy resources provide us with energy. There are different types of energy resources. As you know, one possible classification consists in divide energy resources into two categories, non-renewable and renewable energy resources. According to this classification, put the pictures in the columns below:

Renewable energy resources	Non-renewable energy resources	
	Fossil fuels	Nuclear energy

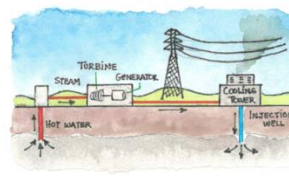
1.



2.



3.



4.



5.



6.



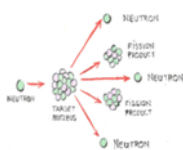
7.



8.



9.



10.



11.



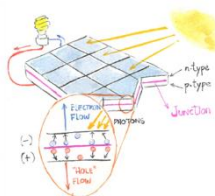
12.



13.



14.



15.



**Activity 9** (7 Points) Complete these sentences using the most suitable word:

- Coal, natural gas and oil are \_\_\_\_\_ (renewable / non-renewable / nuclear fuels) energy resources. They release \_\_\_\_\_ (heat / electricity / radioactivity) when they are burned.
- Wind and solar energy are \_\_\_\_\_ (renewable / non-renewable) energy resources because they \_\_\_\_\_ (can / cannot) be replaced by the nature.
- Coal, natural gas and oil are called \_\_\_\_\_ (nuclear fuels / fossil fuels / renewable sources).
- Two more examples of renewable energies are \_\_\_\_\_ and \_\_\_\_\_.

### Solar energy



The Sun is a huge energy source. At its centre, nuclear reactions called “nuclear fusion” are releasing enormous amounts of energy as heat and light. Almost all our energy comes from the Sun. Without this energy, in the form of heat and light, life on Earth would be impossible. Solar energy can be used in two different ways.

Watch the videos “solar thermal” in “<https://www.youtube.com/watch?v=FgjfJGfusdE>”, about the photo thermal use of solar energy, and “solar photovoltaics” in “<https://www.youtube.com/watch?v=gl5tY5Noacc>”, about the photovoltaic use of solar energy.



#### Optional activities about the video (12 Points; 2 points each question):

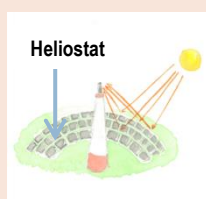
- According to the video, what does it mean solar thermal?
- According to the videos, write the main differences between active and passive solar heating systems.
- Write some advantages and disadvantages in the use of solar energy.
- According to the videos, write the main differences between photo thermal and photovoltaic use of solar energy.
- What is the meaning of solar photovoltaic (PV)?
- What materials solar PV are used use to transform Sun energy into electricity?

#### Photo thermal and photovoltaic use of solar energy

- Solar energy can be used to heat something as for example a fluid (water for example) or heat something by the sunlight reflexions (with mirrors). This kind of use of solar energy is called **Photo thermal**, because heat something. We can use solar panels (or solar collectors), using the fact that all the light that arrives to a parabola surface is focused to the focus, or mirrors (heliostats). A concentrated solar power (**CSP**) uses lots of mirrors that concentrate solar energy on a central collector, achieving high temperatures. Other possibility is the solar oven (most of the times using the greenhouse effect)



Stirling collector

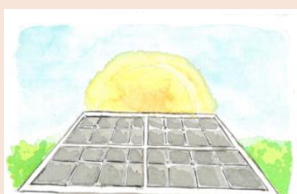


Concentrated solar Power (CSP)

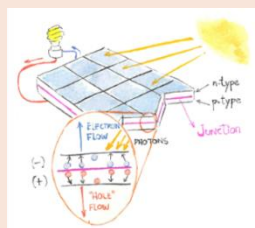


Solar collector used to heat a fluid

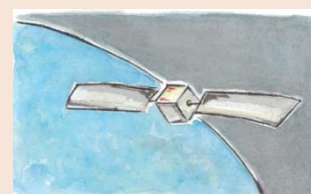
- Solar energy that transforms directly solar energy into electricity by using solar cells is called **Photovoltaic** (solar **PV**).



Solar cell



Photovoltaic effect



Satellite with solar cells

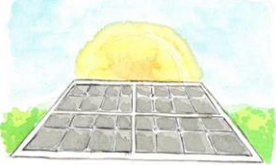

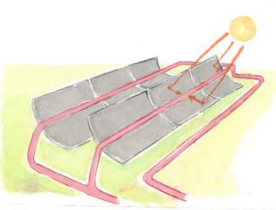


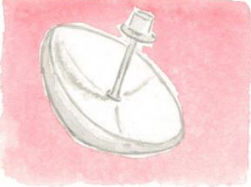
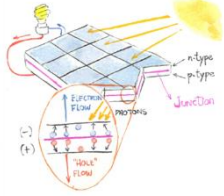
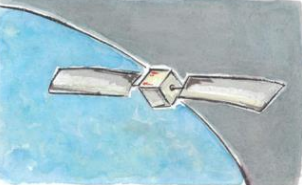


**Activity 10** (8 Points) According to the text, answer the following questions.

- a) (1 P) Where does solar energy come from? *The solar energy comes from* \_\_\_\_\_
- b) (2 P) Solar energy can be converted into \_\_\_\_\_ and \_\_\_\_\_
- c) (2 P) Which is the name of the solar energy used to heat something? \_\_\_\_\_. This kind of way to use the solar energy sometimes needs \_\_\_\_\_ (**collectors / cells**).
- d) (3 P) Photovoltaic use of solar energy converts directly \_\_\_\_\_ energy into \_\_\_\_\_. This kind of way to use the solar energy needs \_\_\_\_\_ (**collectors / cells**).



**Activity 11** (10 Points) Classify the following pictures and names in the columns below, like the example:

Photo thermal use of the solar energy		Photovoltaic use of the solar energy	
1. 	2. 	3. 	4. 
5. 	6. SOLAR CELLS	7. 	8. 
9. SOLAR COLLECTORS	10. 		



**Activity 12** (3 Points) Draw three devices that work with solar energy:

## Wind energy

Watch the video "wind power" in "<https://www.youtube.com/watch?v=Z5c50-hcD0>", about the wind energy.



Optional activities about the video (10 Points; 2 points each question):

1. How wind is produced?
2. What were the traditional uses of wind in the past?
3. How many blades have a usual wind turbine?
4. Wind energy produce CO<sub>2</sub>? Why?
5. Write some disadvantages in the use of wind turbines.



Wind consists in air in movement due to the different hours and quantity of solar radiation received in each part of our atmosphere. Wind has been used for humans for a long time. Ancient Greece used wind to move their sailboats. Windmills were used in all Europe to get flour from the grain, to make some steel machines work, and to pump underground water. In Netherland, windmills were used to get land from the sea. Nowadays, wind energy is used to obtain electricity by using "wind turbines". Wind energy is renewable and doesn't produce atmospheric pollution. Some of the problems we have in the use of wind energy to obtain electricity are: the variability of the wind, the noise produced by wind turbines, the problem in bird migrations and the visual impact. However, wind energy has far more advantages than disadvantages.

For this reason, **European Union** promotes the use of this kind of energy to produce electricity. Spain is leader in this sector. Lots of wind farms are built on land, but there are some wind farms out at sea. In Europe, the amount of electricity generated from wind energy is increasing year by year.



Wind turbines



**Activity 13** (9 points) Read the texts below and after that, match each text with the correct title and with the correct sentences:

### Text 1

*"Fossil fuels cannot provide energy forever". As we finish fossil fuels reserves, in no too much time, people will need to find different ways to obtain energy and renewable sources are a possible solution. Renewable energy is sustainable because it is constantly replaced by the nature, so their use can help us to live in a sustainable world.*

### Text 2

*"The use of wind energy is a great opportunity for people. Having wind farms we can produce our own electricity (saving money) and we can fight against climate change". **Marc Llerol, director of "Wind Manufactures" in Hospitalet de Llobregat, Spain.***

**Text 3**

*"Hundreds of local inhabitants show their threat for the new wind farm, installation". According to Marco Lambutti, inhabitant of Lainate and co-owner of "Endel electric enterprise": "We live in a quite village and noise, visual impact and the change in bird migrations could be a problem in our small city with the wind farm installation. It could change our way of life". Pietro Mancini. Lainate, Italy.*

**Titles:**

**Title 1:** "We have to use more renewable energies"

**Title 2:** "Wind farms; a great business"

**Title 3:** "Threat about the installation of wind turbines"

**Sentences**

**Sentence 1:** Wind turbines will make a lot of noise.

**Sentence 2:** Fossil fuels will be finished in some years.

**Sentence 3:** Wind turbines help the environment.

**Sentence 4:** By using renewable energies we can achieve to live in a sustainable world.

**Sentence 5:** Wind turbines change the direction in which emigration birds fly.

**Sentence 6:** Wind turbines help people to buy less electricity from electrical companies.

**Correct answers:**

TEXT	TITLE	SENTENCE
Text 1	Title: ...	Sentence: ...
		Sentence: ...
Text 2	Title: ...	Sentence: ...
		Sentence: ...
Text 3	Title: ...	Sentence: ...
		Sentence: ...

## Other renewable energy resources

## Hydropower

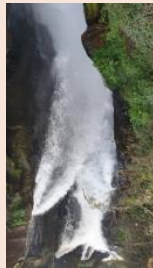
Watch the video "Hydropower" in "<https://www.youtube.com/watch?v=q8HmRLCgDAI>", about hydropower.



Optional activities about the video (10 Points; 2 points each question):

1. What is hydropower?
2. Why hydropower is considered as a renewable energy resource?
3. Write the main differences between the two types of hydropower stations.
4. Write some benefits in the use of hydropower.
5. Write some disadvantages in the use of hydropower.

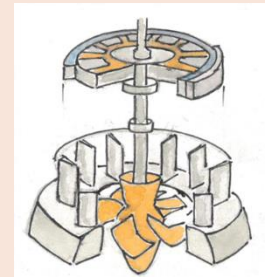
Water wheels have been used for centuries for milling cereals, and can be used to generate electricity as well. The name for turning water energy into electricity is hydroelectric power or **hydropower**. Water moves water turbines that are connected to the generator (moving together) and producing electricity. Hydropower is used in many countries around the world. They are common in countries with mountains, and sometimes we need to build a dam to accumulate water.



Waterfall



Dam



Water turbine



**Activity 14** (6 Points) According to the text "**Hydropower**", match the sentences 1-6 with their endings:

1. Water wheels can be used to generate electricity. The places where it is produced are called	a. water turbines.
2. To obtain electricity we need water with enough kinetic energy to move ...	b. generator
3. Sometimes, to achieve a huge quantity of water we need to build a construction to stop the way of the water called ...	c. hydropower stations.
4. The water is forced into the turbines by ...	d. pressure
5. The electricity is produced by moving the water turbines and the ...	e. dam
6. The further the water falls to reach the turbine, the higher the ...	f. water conductions.

Answers:

1.                      2.                      3.                      4.                      5.                      6.

## Wave's energy

Watch the video "wave energy" in "<https://www.youtube.com/watch?v=sZuc4LMtHoY>", about wave' energy.



## Optional activities about the video (3 Points):

1. What is the name of the three devices used in wave' energy installations?

**Waves** are producing by the wind blowing across the surface of the sea. Waves can be used to move a turbine, producing electricity. There are other possibilities to use waves to obtain electricity such as the "Salter's duck" invented in the 70s by the South African Stephen Salter in Edinburgh. "Pelamis" is other device used to capture wave power to do useful work (electricity).



Waves



Pelamis wave energy converter

## Tidal energy

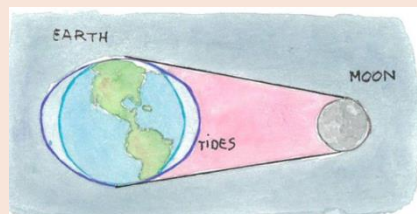
Watch the video "Tidal power" in "<https://www.youtube.com/watch?v=VkJTRcTyDSyk>", about tidal energy.



## Optional activities about the video (5 Points):

1. (2 Points) How tides are produced?
2. (3 Points) What are the three most used tidal technologies?

**Tides** consist in the movement of a huge amount of water each day (due to the sky's bodies influence (attraction) as the moon). We can build a barrage (a large dam built across an estuary with a series of turbines at the bottom), producing different high of water, due to tides, in both sides of the barrier. Water can flow from one side to the other, moving the turbines and producing electricity. In France there is a tidal power station in Rance estuary.



Tides



### Geothermal energy

Watch the video "Geothermal" in "<https://www.youtube.com/watch?v=DFQrE91kZwk>", about geothermal energy.



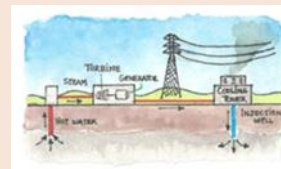
Optional activities about the video (8 Points; 2 points each question):

1. What produce the geothermal energy?
2. What type of water used to use the geothermal energy stations?
3. Write some uses of geothermal energy.
4. Where can we obtain the geothermal energy that can be used?

Earth temperature core is around 3000 °C. In some volcanic areas of the world (for example in Iceland, New Zealand, and parts of North America) hot rocks lie close to the surface. These rocks can be used to heat water. The heated water can be used to heat buildings, to help in agriculture and, in **Geothermal** power stations, to produce electricity. The use of geothermal energy has allowed Iceland to become in one of the Europe's largest producer of bananas. Tropical fruits, produced in hottest places in the world, can be obtained in cold countries with geothermal energy by using heated greenhouses. Italy, France, Germany and parts of Spain all use some geothermal energy.



Geyser



Geothermal power station

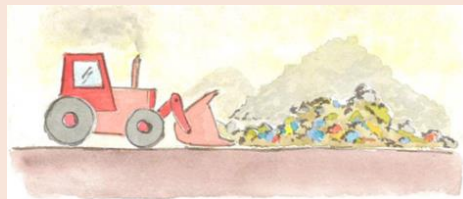


**Activity 15** (5 Points) According to the text "**Geothermal energy**", answer the questions below:

1. (1 P) What is the Earth's core temperature? \_\_\_\_\_
2. (2 P) Name two countries in which the heat rocks lie close to the surface: \_\_\_\_\_, \_\_\_\_\_
3. (1 P) One use of geothermal energy is \_\_\_\_\_
4. (1 P) Which European country is one of the largest bananas producer thanks to the use of geothermal energy? \_\_\_\_\_

### Waste energy

Refused materials (rubbish) or **waste**, can be used in several ways. We can obtain "*pellets*" used to be burned and to obtain heat, we can obtain "*biogas*" used as a fuel, we can "*recycle*" materials (one of the best options) and we can "*incinerate*" it in incinerator power stations to obtain electricity. Special mention to "**municipal solid waste (MSW)**" because should be reduced.



Waste

**Bio fuels and biomass**

Watch the video "Biomass" in "<https://www.youtube.com/watch?v=yHWcddUZ35s>", about biomass.



**Optional activities about the video (8 Points; 2 points each question):**

1. What biomass is?
2. Write some products considered as a Biomass.
3. Write two processes in which we use biomass to obtain energy or other materials that can be used to obtain energy?
4. Biomass used to obtain heat, never produces air pollution (CO<sub>2</sub> and other gases)?

Watch the video "Biofuels" in "<https://www.youtube.com/watch?v=ZGmwtdffc74>", about biofuels.

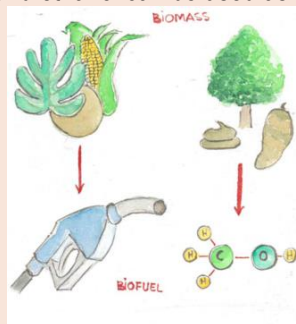


**Optional activities about the video (8 Points; 2 points each question):**

1. What a biofuel is?
2. The term biofuels is usually used to describe liquid fuels such as:
3. How can we obtain ethanol?
4. How can we obtain biofuels?

"**Biomass**" is the organic matter that can be used to obtain energy, by burning it or producing chemical reactions.

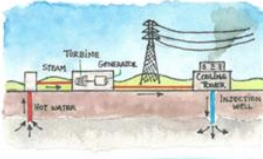

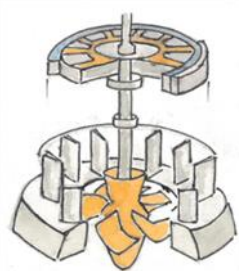


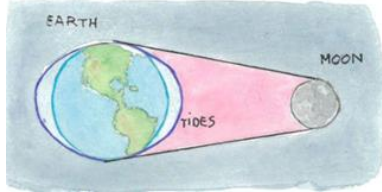
We can obtain "**bio fuels**" such as "*biodiesel*", "*ethanol*" or "*biogas*" by transforming (usually with chemical reactions) vegetal products like plants, fruits, etc. Biodiesel and ethanol can be used as a fuel to power cars.



Biomass and Bio fuels



**Activity 16** (5 Points) Match pictures with the correct energy resource:

<p>1.</p>  	<p>a. HYDROPOWER</p>
<p>2.</p> 	<p>b. TIDAL ENERGY</p>
<p>3.</p> 	<p>c. WASTE ENERGY</p>
<p>4.</p> 	<p>d. GEOTHERMAL ENERGY</p>
<p>5.</p> 	<p>e. WAVE ENERGY</p>

**Answers:**

1.

2.

3.

4.

5.



**Activity 17** (11 points) Match words related from each column.

1. Solar collector	a. Sulphur oxides
2. Wind energy	b. Carbon dioxide
3. Fossil fuel	c. Photo thermal
4. Wave energy	d. Dam
5. Waste energy	e. Moon influence
6. Nuclear energy	f. Coal
7. Geothermal energy	g. Aero turbine
8. Global warming	h. Wind flowing on the sea surface
9. Tidal energy	i. Recycling
10. Acid rain	j. Radioactivity
11. Hydropower	k. Heat from the Earth

**Answers:** 1. 2. 3. 4. 5. 6. 7. 8. 9. 10. 11.





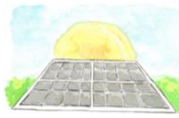







**Activity 18** (9 Points) Match each kind of energy with the correct sentence:

1. Wave power	a. is generated from running water. Dams are built across a lake or river in a valley to trap water. The water flows through tunnels and turns the turbines which make electricity.
2. Geothermal power	b. are used to convert the Sun's energy into electricity.
3. Fossil fuels	c. comes from the movement of water in the sea by the tides. These tides happen twice a day.
4. Hydropower	d. uses the energy of the waves to turn turbines that make electricity.
5. Nuclear energy	e. uses the energy from plants and waste materials to make electricity.
6. Wind energy	f. is made from radioactive uranium ore which occurs naturally in the ground.
7. Tidal energy	g. uses the heat that comes from deep rocks under the surface of the Earth.
8. Biomass	h. were formed in the Carboniferous period, millions of years ago (before the dinosaurs!).
9. Solar panels	i. is used to turn wind turbines and make electricity.

**Correct answers:** 1. 2. 3. 4. 5. 6. 7. 8. 9.



**Activity 19** (10 Points) Complete the grid with the name of the following energy resources:



**Activity 20** (7 Points) Find six different **renewable energy resources** from the table below. There is one that doesn't appear.

Wind	Sun	Tides	Oil	Coal	Biogas	Waste	Waves
Hydropower		Butane	Natural gas		Nuclear energy		

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

Which is the **renewable energy resource** that doesn't appear? \_\_\_\_\_



- g. Air pollution due to sulphurs mixed with water (2 words).
- h. Device used to transform energy to electricity.
- i. Materials we don't use. Usually they are used yet.
- j. Device moved by the water or the steam. Usually is connected with a generator.
- k. Nuclear reaction that means "joining" where two small nuclei combine to form a larger one.
- l. Product from the oil that is used in cars.
- m. Product from the oil that is used in diesel cars.



**Activity 22** (19 Points) Fill in the gaps with the words in the box: (*there are more words than gaps*)

Tides Waves Convection Radiation Fossil fuels Nuclear Coal Nuclear fusion Nuclear fission Oil  
 Natural gas Conduction Conventional energy resources Alternative energy resources Solar energy Hydropower  
 Solar collectors Solar cells Primary energy resources Renewable energy resources Secondary energy resources  
 Non-renewable energy resources

- a. Energy resources that are very used in a country are called \_\_\_\_\_, and the energy resources that are not very used in a country are called \_\_\_\_\_.
- b. Energy resources that can be directly obtained from nature are called \_\_\_\_\_, and energy resources that have to be changed to be used are called \_\_\_\_\_.
- c. Energy resources renovated directly by nature (so we can use its energy forever) are called \_\_\_\_\_, and energy resources that cannot be renovated by nature (so we cannot use it forever because it has finished) are called \_\_\_\_\_.
- d. \_\_\_\_\_ were formed from tiny plants and animals that lived millions of years ago and there are three main groups of this kind of energy resources: \_\_\_\_\_ that is solid, \_\_\_\_\_ that is liquid and \_\_\_\_\_ that is a gas.
- e. There are two types of \_\_\_\_\_ reactions: \_\_\_\_\_ (two small nuclei combine to form a larger one) and \_\_\_\_\_ (the nucleus of an atom is bombarded with neutrons; nucleus splits open, releasing neutrons and large amounts of energy).
- f. \_\_\_\_\_ (energy from the Sun) can be used in two different ways: to heat water using \_\_\_\_\_ or using \_\_\_\_\_ (photovoltaic use) to obtain directly electricity.
- g. The name usually used for turning water energy into electricity is \_\_\_\_\_, sometimes we need a dam in these constructions.
- h. \_\_\_\_\_ are created by the wind blowing across the surface of the sea.
- i. The \_\_\_\_\_ move a huge amount of water each day (by sky's bodies influence (attraction) as the moon).


**Activity 23 (24 Points)** Match texts with a suitable title and with a picture:

**Texts**
**Text 1**

*"If in the future humans want to follow with the actual way of life and with the continuous increasing of the population, it would be absolutely necessary the use of lots of energy. We have to consider the investigation in alternative energy resources. Solar energy could be one of the best solutions to solve the problems. Others energy resource will be needed in the future".*

*Professor Peter McGregor, Dublin University.*

**Text 2**

*"According to the prestigious scientist Marc Hophens, the future of cars should be those who use "electric", "hybrid" or "hydrogen" engines, in order to reduce the gases that produce the climate changes.*

*Mohamed Alkhelali, BP Chief Economist.*

**Text 3**

*"Nuclear fission reactions generate lots of energy and none of the greenhouse gases. To obtain enough energy to live, we have to promote the construction of new nuclear power stations in our country, to have an energy auto sufficiency"*

*The Energy Council 2020, Sweden's energy department.*

**Text 4**

*"The European Union promotes the change in the energy resources used in Europe, to reduce the gases produced in fossil fuels combustions in order to avoid climate changes. Some Europeans countries, like Spain, are increasing the construction of wind farms"*

*Marie Corvignon, France News.*

**Text 5**

*"More fossil fuels reserves have been discovered in many places in the World. In the North Sea, close to the north-east of the U.K, were found about 16 billion of oil barrels. Coal is present in lots of European countries. We could use fossil fuels, in Europe, for a long time."*

*Eddex fossil fuel company magazine.*

**Text 6**

*"Europe has lots of mountains, so it could be possible the use of hydroelectric power stations to produce part of the electricity needed in the European Union. Hydropower is a renewable energy resource that doesn't produce gasses that pollute our atmosphere. Some dams are projected to be built in Europe for the next ten years."*

*Leonidas Testapoulos, the bigger dam's constructor in the World.*

**Text 7**

*"Sunflower fields could be an interesting energy resource. From sunflower oil, it's possible to obtain biofuel that can be used, as a fuel, in cars. It could be an alternative to fossil fuels in the future."*



Martin Scorthner, "Looking for a sustainable World"

**Text 8**

"Some Italian scientists are projecting the use of natural underground steam and hot water to generate electricity in the south of Italy. According to their studies, it could produce part of the electricity and the heat used in Naples."

Alberto Mancinelli, "Il nuovo concetto elettrico italiano"

**Text 9**

"After Chernobyl accident, we can find radioactivity in different parts of Europe. More and more, nuclear waste is very dangerous; can produce different type of cancers and cell mutations. We have to finish with the Nuclear Power Stations in Europe to save our World".

Heiko Schneider, "The end of the nuclear energy"

**Text 10**

"Huge mountains of waste are common in our society. In some places from South America, people use different products, such as metals, obtained from the mountains of waste. This is a dangerous way of live for poor people in these countries, but helps to reduce their waste".

Alberto Peres, "Waste... the footprint of our actual society"

**Text 11**

"The buildings in some Mediterranean areas (Greece, Italy, Spain, Cyprus, etc.) are designed to stay cool in the hot summer. People paint in white colour their walls (using lime most of the time). The white walls reflect the sunlight. As a consequence, it reduces the need to use air conditioning units that spend lots of energy."

Luis Martínez, "Climate architecture in Europe".

**Text 12**




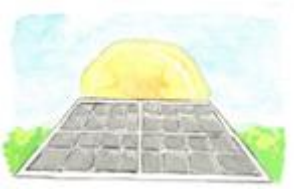


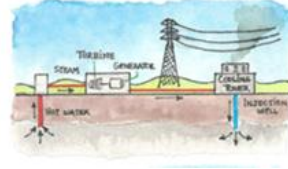
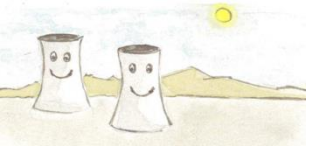
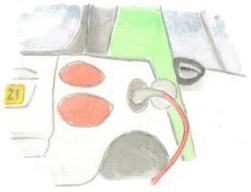



"Some studies in Spain show the possibility to use wave's energy to produce electricity. According to Alberto Perez, the Pelamis is a device very useful to obtain electricity from the waves. Alberto says that using waves we can use less fossil fuels.

Ivor Cloudy, "Other way of obtain electricity it's possible".

**Titles:**

<b>Title 1:</b> Wind energy, the energy for the future
<b>Title 2:</b> <i>People remember the nuclear disaster.</i>
<b>Title 3:</b> <i>Solar energy could be the solution for the future.</i>
<b>Title 4:</b> <i>Some dams are built to produce electricity from the water.</i>
<b>Title 5:</b> <i>White houses in the Mediterranean are energy efficient.</i>
<b>Title 6:</b> <i>Found new oil's reserves.</i>
<b>Title 7:</b> <i>How reduce waste.</i>
<b>Title 8:</b> <i>Other uses of the wave's energy.</i>
<b>Title 9:</b> <i>We need nuclear power stations to produce electricity.</i>
<b>Title 10:</b> <i>Bio fuel uses.</i>
<b>Title 11:</b> <i>The future of cars.</i>
<b>Title 12:</b> <i>How to produce electricity from geothermal energy.</i>

Pictures:

<p>Picture 1</p> 	<p>Picture 2</p> 	<p>Picture 3</p> 	<p>Picture 4</p> 
<p>Picture 5</p> 	<p>Picture 6</p> 	<p>Picture 7</p> 	<p>Picture 8</p> 
<p>Picture 9</p> 	<p>Picture 10</p> 	<p>Picture 11</p>  <p>Don't forget Chernobyl</p>	<p>Picture 12</p> 

Answers: Write the answers in the columns bellow:

Text	Title	Picture
Text 1	Title:	Picture:
Text 2	Title:	Picture:
Text 3	Title:	Picture:
Text 4	Title:	Picture:
Text 5	Title:	Picture:
Text 6	Title:	Picture:
Text 7	Title:	Picture:
Text 8	Title:	Picture:
Text 9	Title:	Picture:
Text 10	Title:	Picture:
Text 11	Title:	Picture:
Text 12	Title:	Picture:



**OPTIONAL Activity 24** (60 Points) **Scale-up activity**. Read next texts and after that, answer the proposed questions:

### To know more about solar energy



We define solar radiation density as:  $\frac{P}{s}$ , (**P** is the power (watts) of solar energy, and **s** is the area ( $m^2$ )). This expression could help us to find, approximately, the number of solar cells we need to obtain the energy needed.

**Example:** If we live in a place with a solar radiation density average of  $1000 \text{ w/m}^2$ , and we have 3 solar cells with an area of  $2 \text{ m}^2$  each one, supposing a solar cells performance of a 30 %, the power we can obtain with the solar cells will be the next one:

**Data:**

$$P ?; \quad \frac{P}{s} = 1000 \text{ w/m}^2; \quad s_{\text{cell}} = 2 \text{ m}^2; \quad 3 \text{ solar cells}; \quad \eta = 30\%$$

#### Solving question:

$3 \cdot 2 = 6 \text{ m}^2$  total area of solar cells.

$$6 \text{ m}^2 \cdot \frac{1000 \text{ w}}{1 \text{ m}^2} = 6000 \text{ w} = P_{\text{solar energy}}$$

Like  $\eta = 30\%$

$$\eta = \frac{P_{\text{useful}}}{P_{\text{produced}}} \cdot 100 \rightarrow P_{\text{useful}} = \frac{\eta \cdot P_{\text{produced}}}{100} = \frac{30 \cdot 6000}{100} = 1800 \text{ w}$$

**P = 1800 w** (P produced by the three solar cells)

If we suppose that the average of useful solar energy in the place is about 7 hours a day, the energy produced by solar energy in a day will be:

(Remember that  $P = \frac{E}{t}$  (P = Power (watts), E = Energy (Joules), t = time (seconds)) and 1 Kwh = 3600000 J)

$$E = P \cdot t = 1800 \cdot (7 \cdot 3600) = \mathbf{45360000 \text{ J} = E}$$
 (E produced by the solar cells in a day expressed in Joules)

Like 1 Kwh = 3600000 J

$$\frac{45360000}{3600000} = 12.6 \text{ Kwh}$$

**E = 12.6 Kwh** (E produced by the solar cells in a day expressed in Kwh)

### To know more about wind energy



We can obtain the useful power (P) from the wind with the equation:

$$P = 0.5 \cdot s \cdot v^3 \cdot \rho \cdot C_p$$

(P = Power (watts); s = area ( $m^2$ ); v = velocity, speed of the wind (m/s);  $\rho$  (density of the air,  $1.225 \text{ Kg/m}^3$  in N.C.);  $C_p$  is the performance with a maximum value of 0.59 (known as Betz limit), usually can change between 0.1 and 0.5 according to the place)

**Example:** Find the power obtained from an aero generator (wind turbine) with blades of 20 m of diameter, a wind speed of 72 Km/h and in a place with  $C_p = 0.35$ .

**Data:**

$$P ?; \quad \varnothing_{\text{blades}} = 20 \text{ m}; \quad v_{\text{wind}} = 72 \text{ Km/h} \quad C_p = 0.35$$

**Solving question:**

Velocity (speed) should be expressed in m/s, so:  $72 \frac{Km}{h} \cdot \frac{1000 m}{1 Km} \cdot \frac{1 h}{3600 s} = 20 m/s$

To find s (area), as blades in its movement produces a circle, the area will be:  $s = \pi \cdot r^2$ , the diameter of the blades will be the radius of the circle, so:  $s = \pi \cdot 20^2 = 1256.64 m^2$

To find P:  $P = 0.5 \cdot s \cdot v^3 \cdot \rho \cdot C_p = 0.5 \cdot 1256.64 \cdot 20^3 \cdot 1.225 \cdot 0.35 = 2155137.6 w = P$  (Power produced for the wind turbine)

**Optional activities about renewable energy resources (60 points):**

- 1) (10 points) After read the text and watch the videos about solar energy, propose some places in your country in which you could install any solar installation, giving the reasons. (Help: Use of solar collectors or solar cells to obtain what, in which parts in your country you would use solar energy and why. Propose different places in the E.U.as well, giving reasons for your choice.

**Help grammar: I would install ... because**

- 2) (10 Points) After read the text and watch the video about wind energy, propose some places in your country in which you could install any wind farm, giving the reasons. (Help: Use of wind turbines to obtain what, you would install the wind farms near or not of a city, in which parts in your country you would install a wind farm and why,...). Propose different places in the E.U. as well, giving reasons for your choice.

**Help grammar: I would install ... because**

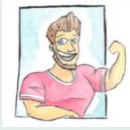
- 3) (20 points) After learn different things about renewable energy resources, imagine that you are living in a world in which people just use these kinds of energies. Describe the imagined world and draw a picture representing it.

**(Help: Which kind of renewable energy resources you would use, to obtain what, and the reasons, where do you would install the energy resources, giving the reasons, how would be the world imagined, etc.)**

- 4) (15 Points) According to the previous text "To know more about solar energy", find the proposed.

A family expends 450 Kwh of electrical energy (1 Kwh = 3600000 J) in a month. Supposing that in this month electricity was used for 210 hours, and the average of solar radiation density in the place is 1000 w/m<sup>2</sup>. Find:

- a) The power used for the family in a month. (Remember:  $Power = \frac{Energy}{time}$ ). Express the power in watts.
- b) If we want to obtain all the energy by using solar energy, find the number of solar cells that we need. **Each solar cell has 1 m<sup>2</sup> of area.** (Suppose a performance of 30%)
- 5) (5 Points) According to the previous text "To know more about energy", find the power obtained for a wind turbine, with blades of 2 meters. Suppose a wind speed average of 40 m/s, a density of the air of  $\rho = 1.225 Kg/m^3$ , and a performance of  $C_p = 0.30$ .



**(Optional activity) Activity 25 (50 extra points)**

Do you want to eat pizza made by solar energy? Maybe some popcorn? So...Let's go to build a solar oven.

There are two types of solar ovens; **the box type** (using the greenhouse effect), and **the parabolic type** (using the convergence of sun rays in a single point). The first one is easier to build, so it's recommended to build the box type. If we talk about the box type, it's possible to build lots of possible solar ovens. It's a question of time, material availability, and imagination!!!



Parabolic type



Box type

Parabolic type is quite difficult to buy, so we are going to build the box type.

**There are lots of possibilities, so the instructions could change a lot. So, look at next videos from YouTube, and look at the pictures from some solar ovens.**

Watch next video from YouTube in which you can follow the instructions to build an easy solar oven: <https://www.youtube.com/watch?v=v5CdNH3sQT0>, or if you want to build an easier oven, you can watch the next one: <https://www.youtube.com/watch?v=Uqmqu2L7kek>, but in fact...you have lots of possibilities...just take a look on the net.

**Materials** you will need to build a box type solar oven (in the video you can follow the instructions):

- One or two carton boxes (two in the case you use pieces of newspaper as insulating, one if you use expanded polystyrene (EPS or porexpan)).
- In the case you use EPS as insulating, you will need 5 pieces of expanded polystyrene (EPS) (measures according to the box); if you use pieces of paper as insulating, you will need some pieces of newspaper (or similar).
- Glue.
- Black paper.
- Some aluminium foils (used in kitchens).
- A piece of glass, polymethyl methacrylate (PMMA), polycarbonate (PC), or a similar transparent plastic (it will be used to produce the greenhouse effect).
- Scotch tape (just if necessary)
- Cutter, scissors or similar.

Remember that if you put the "**reflectors**" we could achieve a higher temperature.

You have here some pictures from solar ovens made by students:

- Built with pieces of newspapers as isolating:



With detachable lid



Without detachable lid (fixed)

Pieces of newspaper



Inside box (2 boxes)



Cover pieces of newspaper



Glass or transparent plastic

Top of the box



- Built with EPS:

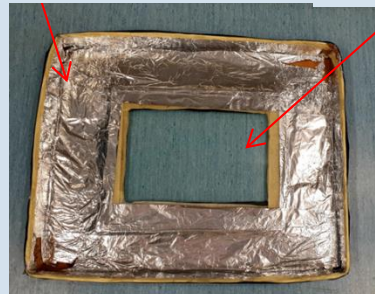
EPS covered by aluminium foils

EPS covered by aluminium foils

Glass or transparent plastic



Inside, just one box needed



Top of the box

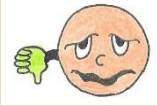





Now, build your solar oven and enjoy with your pizza or your pop corns using solar energy!!! That's great!!!



**Peer' assessment.** Assess pair activities. Your name: \_\_\_\_\_ Group:

Put a tick in the right columns in the grid below, and assess your partner's work:





YOUR PARTNER'S NAME:	What to evaluate:				
		COULD BE BETTER 1	SATISFACTORY 2	GOOD 3	VERY GOOD 4
	Help doing the activities				
	Respects your solutions				
	English level (oral)				
	Follows instructions				
	Adds different ideas				
	Makes/answers questions				
	Proposes solutions				
<b>TOTAL</b>					<b>/28</b>



**Self-assessment** Assess yourself:

About the scenario:

1. Make a cross in the table below, according to the things you have learned in this scenario:

What to evaluate				
	Could be better 1	Satisfactory 2	Good 3	Very good 4
I learnt some vocabulary related to energy resources.				
I know the main energy resources classifications.				
I can classify energy resources according to the different classifications.				
I can describe and identify renewable and non-renewable energy resources.				
I can describe fossil fuels.				
I can describe the two nuclear reactions.				
I can describe the solar energy and the different way to be used (photo thermal and photovoltaic)				
I can describe what the wind energy is.				
I can describe how we can use hydropower.				
I can describe what tidal energy is.				
I can describe what geothermal energy is and its uses.				
I can describe the main uses of waste.				
I can describe how we can use biomass and biofuels.				
I can draw different devices that use renewable energy resources.				
I can describe situations in which we need the use of energy.				
I can understand graphs and give conclusions.				



I can read a text and match to a title and/or a picture.				
I can solve word search about renewable energy resources.				
I can solve a crossword about energy resources.				
I'm able to give reasons, expressing my opinion.				
I can watch a video and answer questions about it.				
I enjoy working in groups.				
<b>TOTAL</b>				<b>/88</b>

2. Write your mark with a cross (a number between 1 and 10).

1	2	3	4	5	6	7	8	9	10
---	---	---	---	---	---	---	---	---	----

3. What have you learned from this scenario?
4. What was easy for you?
5. What did you find difficult?
6. What would you find most helpful?
7. What did you like doing most?
8. What did you like doing least?
9. Write the most important words (key words) learned in this scenario.
10. Any suggestions?

**In this scenario you have...**

- ❖ Used English as a way to communicate.
- ❖ Worked in pairs, respecting and analysing critically the decisions made by your partners.
- ❖ Learnt some vocabulary related to energy resources.
- ❖ Used the two most important energy units.
- ❖ Identified different energy resources classifications.
- ❖ Identified renewable and no-renewable energy resources.
- ❖ Identified fossil fuels
- ❖ Described the two nuclear reactions.
- ❖ Identified the ways to use solar energy (photo thermal and photovoltaic)
- ❖ Described the use of wind energy.
- ❖ Described the use of hydropower.
- ❖ Described the use of waves, tidal and geothermal energies.
- ❖ Identified the uses of waste, biomass and biofuels.
- ❖ Understood a graph giving conclusions about it.
- ❖ Understood the importance in the use of renewable energy resources in our society, and identified the promotion of these energies in the European Union.
- ❖ Solved word search and crosswords.
- ❖ Used internet to improve your knowledge.
- ❖ Learnt how to write a definition in English.
- ❖ Learnt how to compare in English.
- ❖ Learnt how to give opinions in English.
- ❖ Built a solar oven.