HIGHER
PHYSICS UNIT 1 – ENERGY

In this topic you will discover different energy stores and how that energy is transferred by heating, electrically, mechanically and by radiation. You will cover how to calculate energy stored by gravitational potential, kinetic and elastic potential. You will calculate the power or energy transfers and the efficiency of energy transfers. You will then look at energy resources and their use in our lives. You will finally learn about the thermal conductivity of materials and their use in transferring energy by heating.

This will build on the work you did in Y7 about energy stores and transfers and the work you did in Y9 about energy transfers and energy resources.

This will help you prepare to make informed decisions in the future about energy resources and insulating your home.

Name:

Class:

Teacher:

Target:

ENERGY STORES AND TRANSFERS **Date:**

ACTIVATE KNOWLEDGE

ENERGY STORES

Gravitational Potential	When objects are raised above the ground, they have this energy store.
Elastic Potential	When objects are squashed or stretched, they have this energy store.
Electrostatic	When charged particles build up on objects, they have this energy store.
Kinetic	All moving objects have this energy store, no matter how big or small, from atoms to planets.
Magnetic	Objects that have a magnetic field have this energy store.
Nuclear	This is the energy store in the nucleus of atoms and is released during nuclear reactions.
Chemical	This is the energy store in the bonds between particles. It is released when particles react and bonds are broken.
Internal / Heat	All hot objects have this energy store.

CONTENT

A system can store energy. A system is an object or group of objects.
There are eight ways energy can be stored in a system. We call these energy stores.

We live in a world of change. Systems are constantly changing. This means that the energy stored in a system changes too. Energy can be transferred between different energy stores.

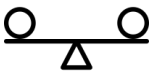
Energy Store 1 → THE OBJECT CHANGES / ENERGY IS TRANSFERRED → **Energy Store 2**

Gravitational Potential → AN APPLE FALLS FROM A TREE / ENERGY IS TRANSFERRED → 

Kinetic

Chemical → FUEL IS BURNT / ENERGY IS TRANSFERRED → 

Internal



Energy Conservation

The Law of Conservation of Energy states that:

Energy cannot be created or destroyed, only transferred.

TOTAL ENERGY BEFORE TRANSFER → TOTAL ENERGY AFTER TRANSFER

DISSIPATED ENERGY **Date:**

RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is an object or group of objects called?		
2	Complete the law of conservation of energy: Energy cannot be…		
3	What energy store is in the bonds between particles?		
4	What energy store do all moving objects have?		
5	What energy store do objects have when raised above the ground?		
6	What energy store do charged objects have?		
7	What energy store do all hot objects have?		
8	What energy store is within the nucleus of atoms?		
9	What energy store do magnets and electromagnets have?		
10	What energy store do stretched or squashed objects have?		
	Score		

ACTIVATE KNOWLEDGE

The eight energy stores are:

G

E

E

K

M

N

C

H

The law of Conservation of Energy states that:

CONTENT

ENERGY TRANSFERS

USEFUL ENERGY

Energy Transfers that we want to happen.

WASTED ENERGY

Energy Transfers that we don't want to happen.

WASTED ENERGY IS DISSIPATED TO THE SURROUNDINGS

WASTED ENERGY IS OFTEN TRANSFERRED AS HEATING WHICH INCREASES THE TEMPERATURE OF THE SURROUNDINGS.

REDUCING UNWANTED ENERGY TRANSFERS

LUBRICATION

Lubrication reduces the amount of friction that occurs when objects move over each other. This reduces the unwanted energy transferred mechanically.

THERMAL INSULATION

Thermal Insulation reduces the amount of unwanted energy transferred by heating between objects of different temperatures.

POWER **Date:**

RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What force does lubrication reduce?		
2	Which energy transfer is caused by a force?		
3	What are the units of energy? (give the name and symbol)		
4	What is the name of the energy transfer which causes a change in temperature?		
5	What is the name given to energy transferred by waves?		
6	What is another name for wasted energy?		
7	What happens to the wasted energy of a system?		
8	What energy transfer is caused by the force on an object?		
9	What energy store do moving objects have?		
10	How is energy transferred in battery powered devices?		
	Score		

ACTIVATE KNOWLEDGE

THE FIFA METHOD FOR CALCULATIONS

F	FORMULA	Identify what you need to calculate and what information you are given then write the equation that you need to use.
I	INSERT VALUES	Write the numbers from the question into the correct place. This will automatically get you a mark.
F	FINE TUNE	Some questions will need to be rearranged to change the subject or some units will need to be changed here. This will get you a mark if needed.
A	ANSWER	Type the final calculation into a calculator and give your answer to the correct decimal place or significant figure and add units if required. This will get you at least one mark.

CONTENT

POWER

Power is a measure of the **rate of energy transfer**.

NOTE: Work Done is a phrase used to describe energy transferred.

Equation:

Power = Energy Transferred / Time

Equation:

Power = Work Done / Time

We measure Power in Watts (W)

We measure Energy Transfer (Work Done) in Joules (J)

We measure Time in Seconds (s)

What is a Watt?

One Joule per second

EFFICIENCY **Date:**

RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What energy store do all moving objects have?		
2	What is another phrase used to describe energy transfer?		
3	Which energy transfer is caused by charges moving in a circuit?		
4	What is the equation that links work done, force and distance?		
5	What materials are used to reduce wasted energy transfers caused by friction?		
6	What happens to the wasted energy of a system?		
7	What is the equation that links power, energy transferred at time?		
8	What equation links gravitational potential energy, mass, gravitational field strength and height?		
9	What energy store do food and fuel have?		
10	What equation links kinetic energy, mass and speed?		
	Score		

ACTIVATE KNOWLEDGE

What does the conservation of energy state?

What is a useful energy transfer?

What is a wasted energy transfer?

What is another name for wasted energy?

What happens to wasted energy?

CONTENT

EFFICIENCY

Efficiency is the proportion or percentage of useful energy transferred.

Equation:

Efficiency = useful energy output / total energy input (x100)

Equation:

Efficiency = useful power output / total power input (x100)

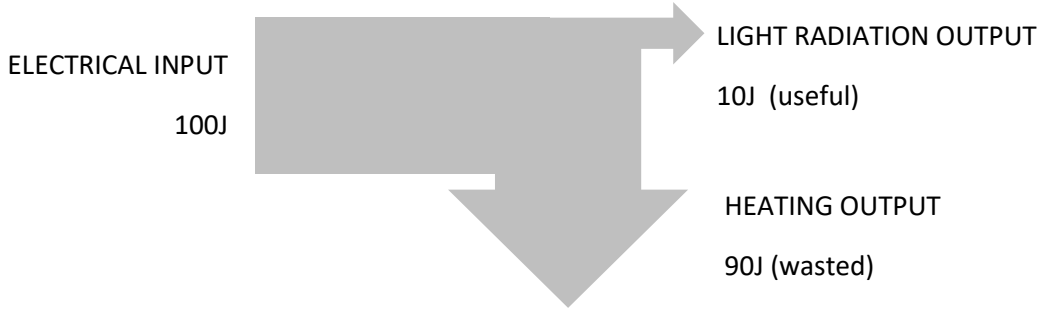
We measure Efficiency in percentage (%) but can be left as a decimal.

We measure Energy in Joules (J)

We measure Power in Watts (W)

SANKEY DIAGRAMS

Sankey diagrams are a visual way to represent how much energy is useful and how much energy is wasted by a system. The wider the arrow, the more energy it represents.



CALCULATING GRAVITATIONAL POTENTIAL ENERGY STORE Date:

RETRIEVAL ACTIVITY

1. What are the eight energy stores? (8)

G

E

E

K

M

N

C

H

2. A spring loaded toy car drives up a ramp. What are the energy transfers? (3)

a) At first, energy is stored in the car's spring. The energy is stored as…

b) When the car starts to move, the energy is transferred and now stored as…

c) As the car moves up the ramp, energy is transferred and now stored as…

3. Complete the law of conservation of energy below. (2)

Energy cannot be…

Score / 13

ACTIVATE KNOWLEDGE

How do you increase the gravitational potential energy stored in an object?

Book A is on a 1m high shelf. An identical Book B is on a 2m high shelf. Which book stores more energy?

What is mass?

CONTENT

Gravitational Potential Energy

DEPENDS UPON MASS

DEPENDS UPON GRAVITATIONAL FIELD STRENGTH

DEPENDS UPON HEIGHT

Equation:

gravitational potential energy = mass x gravitational field strength x height

We measure Gravitational Potential Energy in Joules (J)

We measure Mass in Kilograms (kg)

We measure Gravitational Field Strength in Newtons per Kilogram (N/kg)

We measure Height in Metres (m)

NOTE: On Earth, the gravitational field strength is 9.81 N/kg which is often rounded to 9.8 or 10 N/kg. In the exam it will tell you which one to use.

CALCULATING KINETIC ENERGY STORE

Date:

RETRIEVAL ACTIVITY

	Description	Energy Store	Mark
1	A magnet.		
2	Objects raised above the ground have this energy.		
3	A stretched Slinky.		
4	The energy stored in food and fuel.		
5	Energy stored in hot objects.		
6	Energy stored in moving objects.		
7	Hair stuck to a charged balloon.		
8	Energy stored in squashed or stretched objects.		
9	Energy stored in the nucleus of atoms.		
10	Man running.		
	Score		

ACTIVATE KNOWLEDGE

What objects store kinetic energy?

What is speed?

List the states of matter from least to most kinetic energy stored.

Race Car A travels at 10 m/s. Identical Race Car B travels at 20 m/s. Which car has more kinetic energy stored?

CONTENT

DEPENDS UPON MASS ..... **Kinetic Energy** ..... DEPENDS UPON SPEED

Equation:

$$kinetic\ energy = \tfrac{1}{2} \times mass \times (speed)^2$$

We measure Kinetic Energy in Joules (J)

We measure Mass in Kilograms (kg)

We measure Speed in Metres per Second (m/s)

CALCULATING ELASTIC POTENTIAL ENERGY

Date:

RETRIEVAL ACTIVITY

1. What equation links gravitational potential energy (Ep), mass (m), gravitational field strength (g) and height (h) ? (1)

2. What equation links kinetic energy (Ek), mass (m) and velocity (v)? (1)

3. What energy is stored in a battery, fuel and food? (1)

4. What energy is stored in hot objects like a radiator? (1)

5. What energy is stored in charged objects? (1)

6. True/False: Energy cannot be created or destroyed, only transferred. (1)

7. How does doubling the mass effect the gravitational field strength of an object? (1)

8. What are the units of energy? (1)

Score / 8

ACTIVATE KNOWLEDGE

What objects store elastic potential energy?

What word describes how much an object is stretched?

Spring A is stretched 2m and spring B is stretched 4m. Which stores more energy?

CONTENT

Elastic Potential Energy

DEPENDS UPON SPRING CONSTANT

SPRING CONSTANT IS HOW STIFF A SPRING IS

DEPENDS UPON EXTENSION

EXTENSION IS THE LENGTH A SPRING IS STRETCHED BY

Equation:

$$elastic\ potential\ energy = 0.5 \times spring\ constant \times (extension)^2$$

NOTE: This equation will be given on your Physics equation sheet. You DO NOT need to learn it.

We measure Elastic Potential Energy in Joules (J)

We measure Spring Constant in Newtons per Metre (N/m)

We measure Extension in Metres (m)

NON- RENEWABLE ENERGY RESOURCES

Date:

RETRIEVAL ACTIVITY

1. What equation links kinetic energy, mass and speed? (1)

2. What is the equation that links power, work done and time? (1)

3. What is another phrase used to describe work done? (1)

4. What is the equation used to calculate efficiency form useful power output and total power input? (1)

5. As well as power, what else can we measure the efficiency of? (1)

6. What is the name of the diagrams, made up of arrows, used to represent the energy transfers in a device? (1)

7. What energy is stored in a battery? (1)

8. What energy is stored in fuels? (1)

9. What energy is stored in radioactive substances? (1)

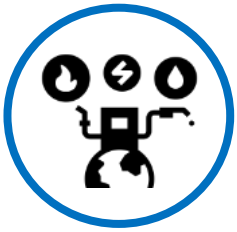
10. What is the law of conservation of energy? (1)

THINK HARD QUESTION

Describe the change in energy when the brakes of a car are pressed. (3)

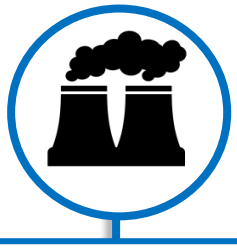
Score / 13

ACTIVATE KNOWLEDGE



ENERGY RESOURCES

CONTENT



NON-RENEWABLE ENERGY RESOURCES

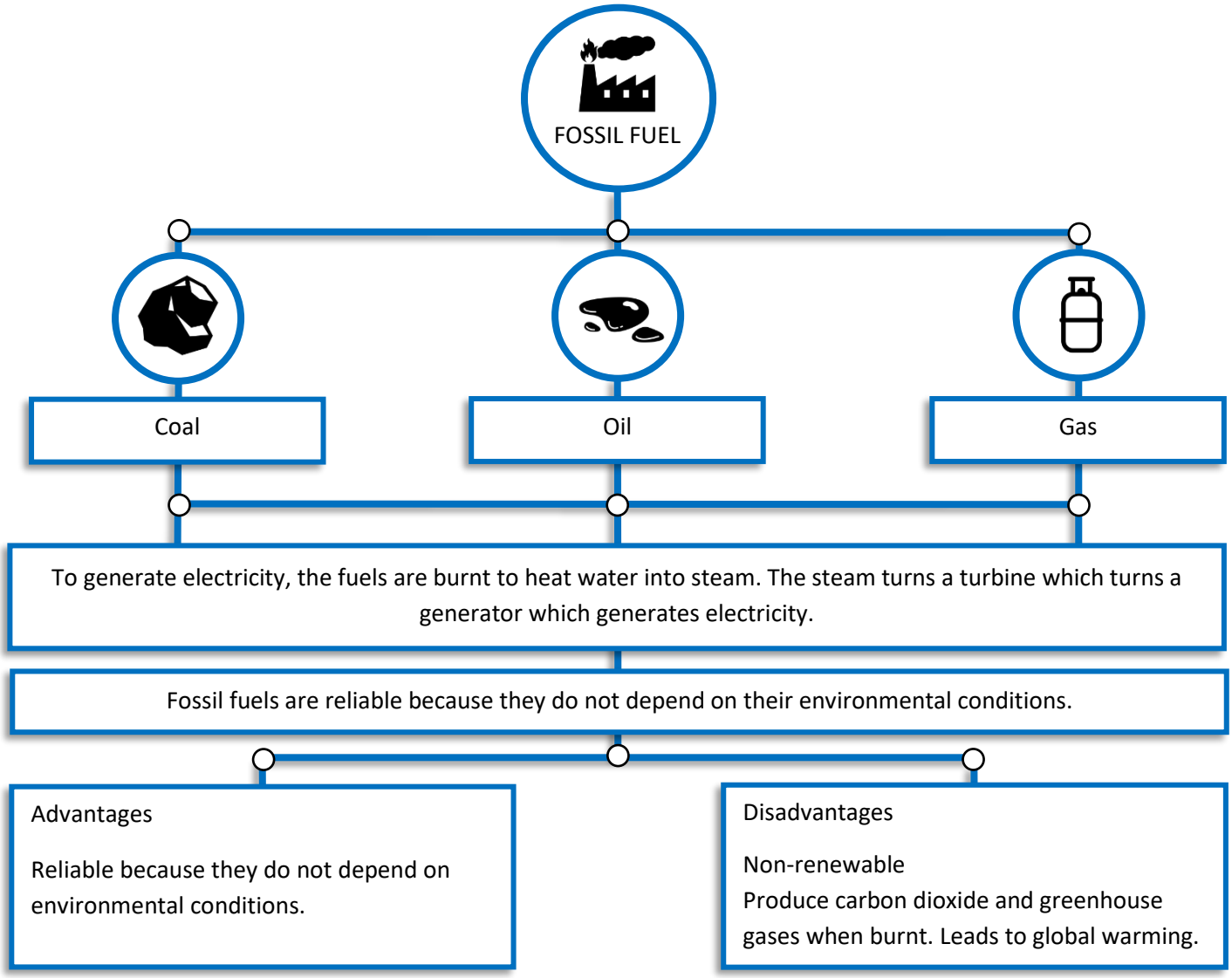
Non-renewable energy resources are resources that will eventually run out.

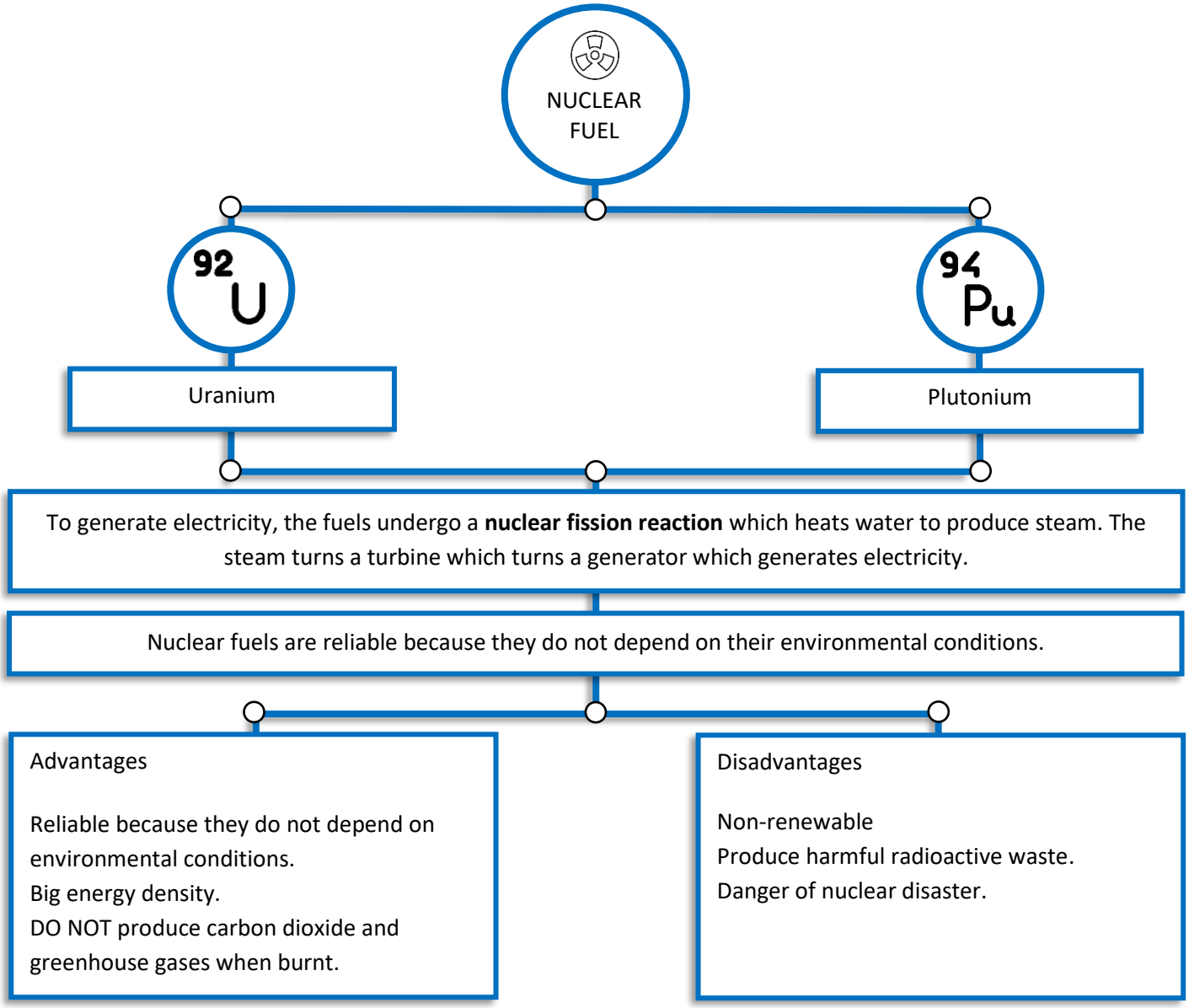
Uses

- Generating Electricity
- Heating
- Transport

There are two non-renewable energy resources:

- Fossil Fuels
- Nuclear Fuels


FOSSIL FUEL
Coal
Oil
Gas
To generate electricity, the fuels are burnt to heat water into steam. The steam turns a turbine which turns a generator which generates electricity.
Fossil fuels are reliable because they do not depend on their environmental conditions.
Advantages
Reliable because they do not depend on environmental conditions.
Disadvantages
Non-renewable
Produce carbon dioxide and greenhouse gases when burnt. Leads to global warming.


NUCLEAR FUEL
92 U
Uranium
94 Pu
Plutonium
To generate electricity, the fuels undergo a **nuclear fission reaction** which heats water to produce steam. The steam turns a turbine which turns a generator which generates electricity.
Nuclear fuels are reliable because they do not depend on their environmental conditions.
Advantages
Reliable because they do not depend on environmental conditions.
Big energy density.
DO NOT produce carbon dioxide and greenhouse gases when burnt.
Disadvantages
Non-renewable
Produce harmful radioactive waste.
Danger of nuclear disaster.

RENEWABLE ENERGY RESOURCES **Date:**

RETRIEVAL ACTIVITY

	Question	Answer	Mark
1	What is the name of energy resources that will eventually run out?		
2	What are the three fossil fuels?		
3	What are the two nuclear fuels?		
4	What gas is produced when fossil fuels are burnt?		
5	Why are greenhouse gases bad for the environment?		
6	What happens to the wasted energy of a system?		
7	What are the units used to measure power?		
8	What are the units used to measure mass?		
9	What energy store do food and fuel have?		
10	What are the units used to measure force?		
	Score		

ACTIVATE KNOWLEDGE

What is a non-renewable energy resource?

What are the two non-renewable energy resources?

CONTENT

RENEWABLE ENERGY RESOURCES

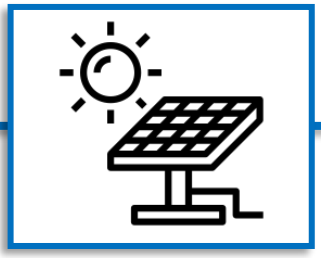
Renewable energy resources are energy resources that will never run out.

RENEWABLE ENERGY RESOURCES

WIND

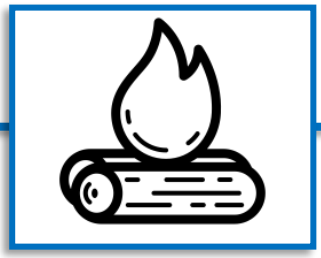
Wind turns turbines and generators which generates electricity.

SOLAR



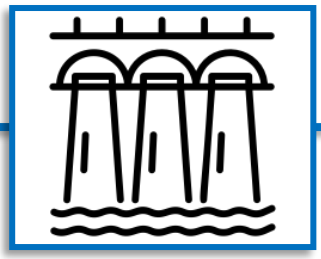
Solar cells use sunlight to generate electricity.

BIOFUEL



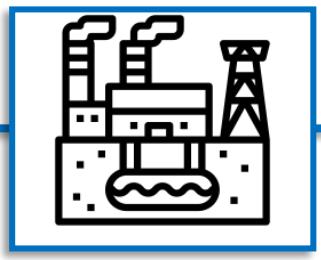
Fuel from a recently living organism which can be burnt.

HYDROELECTRIC



Water high in a dam flows down and turns a turbines and generators which generates electricity.

GEOTHERMAL

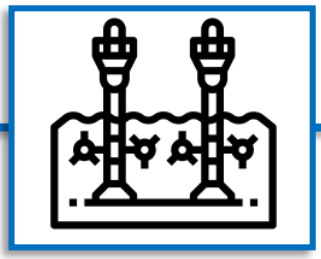


Hot rocks underground heat water to produce steam which turns turbines and generators to generate electricity.

TIDAL

Tidal barrages in an estuary use tides moving in and out to turn turbines and generators to generate electricity.

WAVE



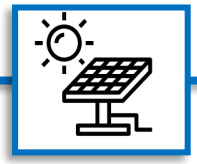
Water waves turn turbines and generators to generate electricity.

RENEWABLE ENERGY ADVANTAGES AND DISADVANTAGES

WIND

ADVANTAGES
- Renewable
- No pollutant gases
- No fuel costs

DISADVANTAGES
- Unreliable
- Visual Pollution
- Noise Pollution



SOLAR

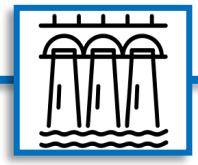
ADVANTAGES
- Renewable
- No pollutant gases
- No fuel costs

DISADVANTAGES
- Unreliable
- Visual Pollution
- Not efficient

BIOFUEL

ADVANTAGES
- Renewable
- Reliable

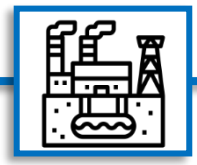
DISADVANTAGES
- Produces Carbon Dioxide
- Leads to Global Warming
- Takes up land



HYDROELECTRIC

ADVANTAGES
- Renewable
- No pollutant gases
- No fuel costs
- Reliable

DISADVANTAGES
- Can cause flooding
- Damage habitats
- Damage wildlife



GEOTHERMAL

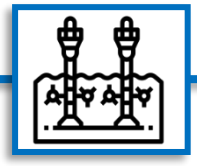
ADVANTAGES
- Renewable
- Reliable
- No fuel costs

DISADVANTAGES
- Needs a volcanic area
- Expensive

TIDAL

ADVANTAGES
- Renewable
- No pollutant gases
- No fuel costs

DISADVANTAGES
- Damage habitats
- Damage wildlife
- Unreliable



WAVE

ADVANTAGES
- Renewable
- No pollutant gases
- No fuel costs
- Reliable

DISADVANTAGES
- Damage habitats
- Damage wildlife
- Visual Pollution