

Energy Requirements

SECTION 1.3

Energy requirements

Energy is needed throughout the entire process of making, using and disposing of a product.

Energy is needed in all the following processes:

- Obtaining materials – use of oil to run machine to mine ores or pump oil out of the ground.
- Refining materials – use of electricity to run factories to refine oil, of gas to smelt metals into pure forms.
- Changing the materials shape – use of heat to melt metals for casting, use of electricity for heater to mould plastics and electricity to run motors on machines.
- Changing its properties – use of gas or electricity to complete surface treatments on materials such as Hardening
- Transporting the materials – use of fuel or electricity for vehicles.



Sources of Energy

There are two types:

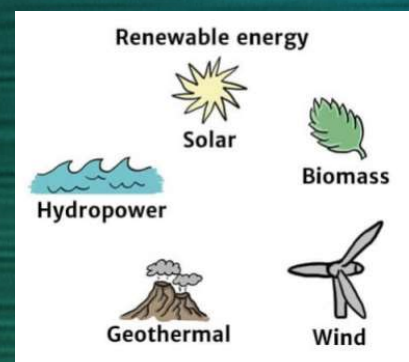
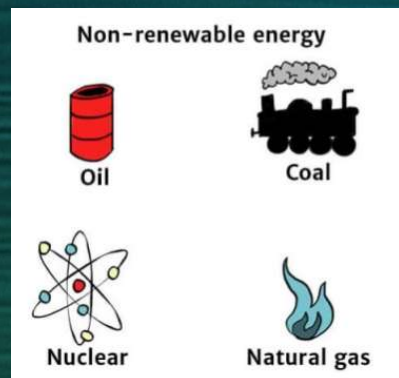
- Renewable
- Non Renewable

Non Renewable means that the energy source will eventually run out, these are often referred to a fossil fuels.

Example: only a certain amount of crude oil exists so that once it is gone then it is gone forever.

Renewable energy sources are sources that come from Renewable sources like the sun, wind or tidal and these will never run out. These sources are much more sustainable as they can be used again and again without running out.

The generation of energy is the same in most cases as it turns a turbine which generates electricity. For example Coal. Oil or gas is burnt to heat water and the steam produced is used to turn a turbine generating electricity. A wind turbine generates electricity by the wind turning the blades which then turns a turbine generating electricity. Solar power can be generated two ways either through the heating of water via the sun or by the movement of particles which then generate electricity.



| Energy production method | Sustainability | Energy source |
|--------------------------|----------------|------------------------|
| Fossil fuels | Non Renewable | Oil, Gas and Coal |
| Wind | Renewable | Wind |
| Tidal | Renewable | Movement of tides |
| Biomass | Renewable | Wood, food oils, waste |
| Solar | Renewable | Sun |

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Name and explain the five steps where energy is used to make a product

- 1, _____

- 2, _____

- 3, _____

- 4, _____

- 5, _____

Where else is energy used when designing and manufacturing an engineered product?

Name the two main sources of Energy

- 1, _____
- 2, _____

Explain each type

Type 1 _____

Type 2 _____

Explain how both type generally create energy

Complete the table

| Energy production method | Sustainability | Energy source |
|--------------------------|----------------|---------------|
| | | |
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| | | |

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Non Renewable energy sources

Fossil fuels

Fossil fuels include Coal, Oil and gas both natural and shale. These fuels have been used for over 100 years to generate the world energy. These fossil fuels are burnt in large furnaces where the heat is used to heat water that will turn to steam. The steam is then used to turn a turbine which then generates electricity.

The advantages of burning Fossil fuels are:

- It is a reliable technology, electricity can be generated as needed,
- Responding quickly to demand.
- Power stations already exist so very little investment is needed

The disadvantages of burning fossil fuels are:

- By products are damaging to the environment (smog, CO₂, acid rain)
- Price of fossil fuels due to increase as they become rarer.

Nuclear power

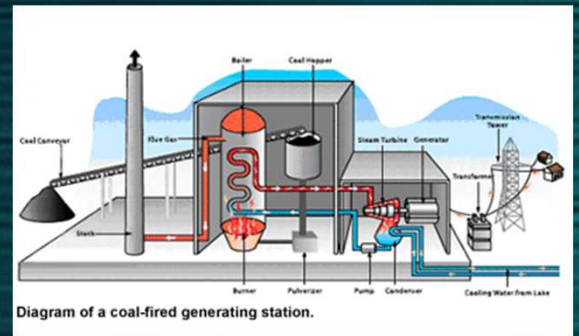
This power sources uses radioactive materials such as Uranium, when enough radioactive material is put together it creates a nuclear pile and generates heat used to heat water turning it to steam to turn generators.

The advantage of nuclear power are:

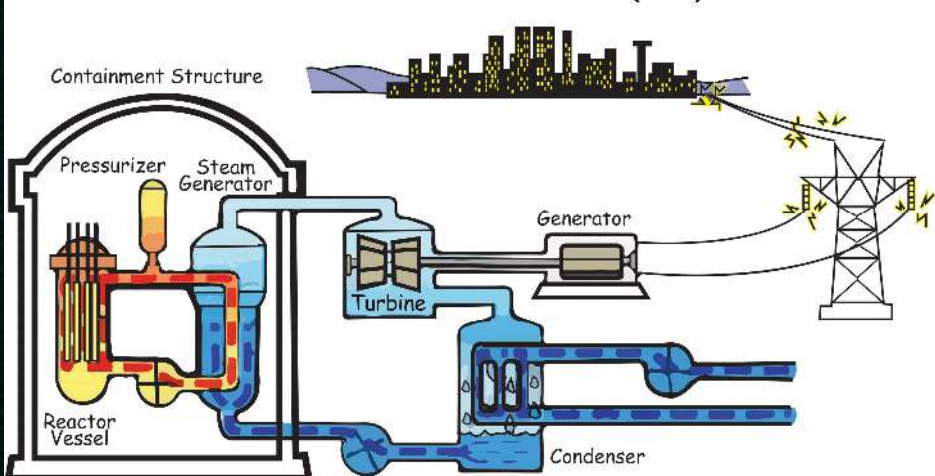
- Produces low cost power
- Electricity produced 24hrs a day
- Responds to demand quickly

The disadvantage of nuclear power are:

- Radioactivity is damaging to environment and living things
- Nuclear disasters can cause devastation across a wide area
- Very expensive to build due to safety features needed.



The Pressurized-Water Reactor (PWR)



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Renewable energy sources

Wind power

This power source has been used for centuries to grind grain into flour. Modern use of wind involves using large blades that turn in the wind and as they turn the axial is connected to a gear box that maintains the rate of turn so even in little wind electricity is still being generated. The blades are connected to a generator to create electricity.

The amount of energy collected is related to the size of the wind turbine and how quickly they rotate. A small wind turbine with blades 300mm in length can produce enough electricity to run a small piece of equipment. However, larger land based wind turbine with blades 10m long and off shore sea turbines with blades 75m long can generate enough power to supply several thousand homes, but only in small groups of 6. Groups of wind turbines are known as wind farms and are becoming increasing common.

The advantage of wind turbines are:

- Electricity is produced at a low cost
- Little maintenance needed
- Wind is free

The disadvantage of wind turbines are:

- Only produce electricity when it is windy
- Cost of building the wind turbines
- People think they are ugly

Tidal power

This power source uses the power of the tides to generate electricity similar to wind with turbines placed under the sea.

The advantage of tidal power are:

- Always tides
- Predictable (2 times a day)
- Can be located where people don't mind – out of view
- Can be combined with off shore wind farms to maximize power output.

The disadvantage of tidal power are:

- Can be difficult to set up
- May have a negative effect on the environment

Biomass

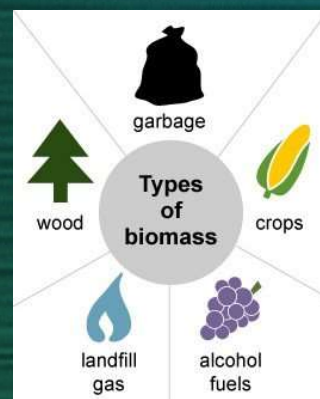
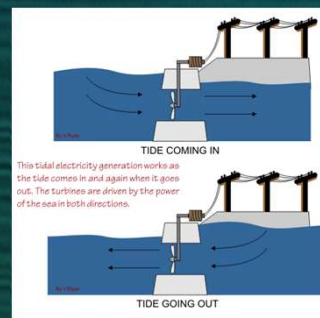
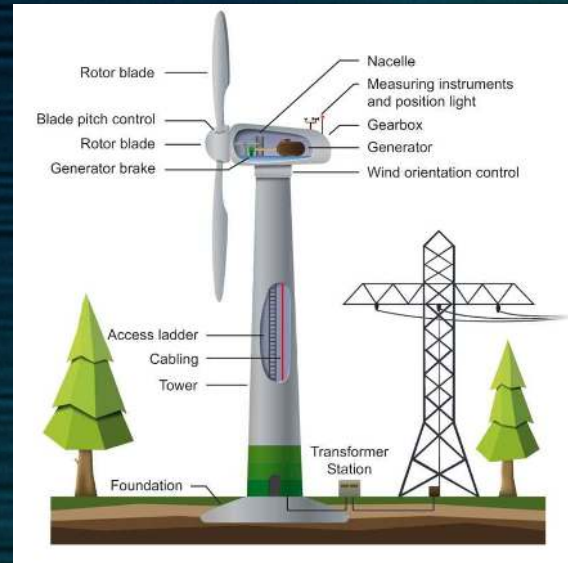
This power source is made from waste organic material such as: wood, plants, vegetable oils, fermented liquids (alcohol) and even animal waste. These fuels can then be burnt to generate electricity in the same way as fossil fuels.

The advantage of Biomass is that they are:

- Uses a waste product that would otherwise end up in land fill or incinerator
- Sustainable as there will always be waste to burn.

The disadvantage of Biomass is that they are:

- Not as much power output compared to fossil fuels
- Produces pollution



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Wind

Explain how Wind can be used as an energy source

Draw down a diagram to explain the source

What are the main advantages of using Wind as an energy source?

What are some of the disadvantages?

Tidal

Explain how Tidal power works

Draw down a diagram to explain

What are the main advantages of using Tidal as an energy source?

What are some of the disadvantages?

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Solar power

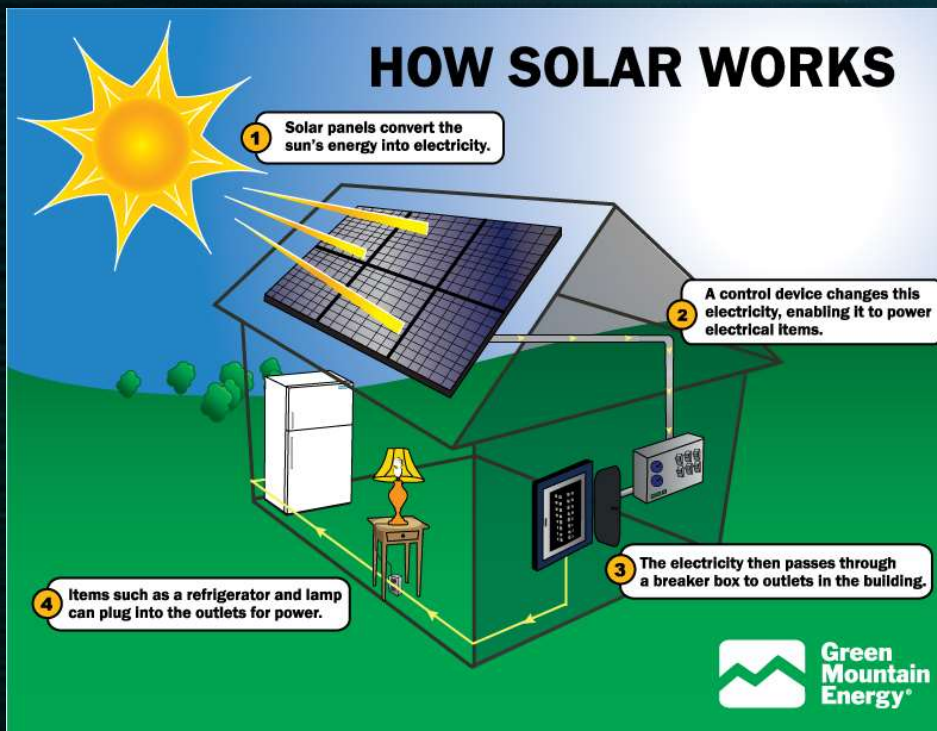
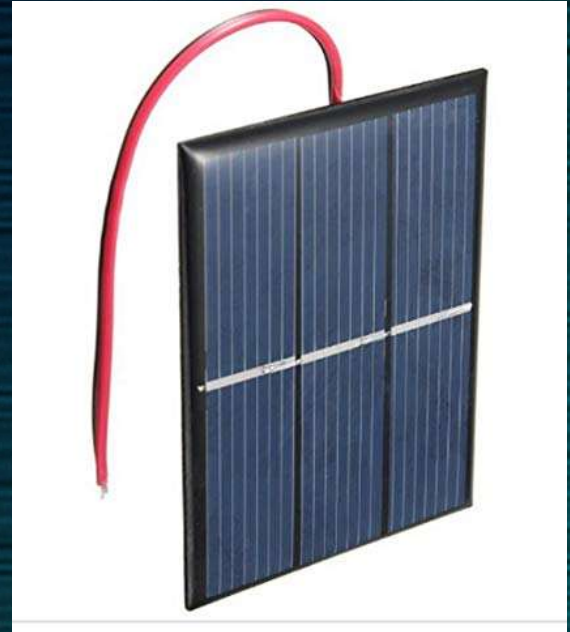
This power source uses sun light to generate electricity which is different from other sources because it doesn't involve turning a generator. Instead the light falls on the Photovoltaic cell which in turn produces electricity.

The advantage of solar power are:

- Sun light is free
- Very little maintenance is needed

The disadvantages of solar power is:

- The cost of the photovoltaic cells
- Not always sunny
- Cost of storing electricity generated during the day
- The amount of solar panel needed
- The cost of land they are put on
- Can't be used for anything else



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Biomass

What the main fuel sources from Biomass?

- 1,
- 2,
- 3,

Explain how Biomass can be used to generate electricity

What are the main advantages of using Biomass as an energy source?

What are some of the disadvantages?

Solar Power

Explain how Solar power works

What can effect the electricity created from this energy source?

What are the advantages to using Solar power as an energy source?

What are the main disadvantages to using Solar power as an energy source?

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Engineered life span

Most products have a limited life span either due to deterioration or on purpose by design or Planned obsolescence.

Planned obsolescence is where a product has been designed to only last for a limited amount of time either due to safety issues or as part of a business plan.

There are three main types of Planned obsolescence:

- Quality – product wears out or breaks
- Function – Product becomes out of date or improved products are available
- Desirability – product designed to go out of fashion

Planned obsolescence could involve materials wearing out, could involve seal casing so internal components cannot be accessed so a new product has to be purchased.

The advantage of Planned obsolescence is:

- Manufacture able to sell more products
- User buys a replacement product
- Reduce need for maintenance

The disadvantage of Planned obsolescence is:

- Places extra demand on the environment
- Use of additional resources

Maintenance of Engineered products

Maintenance is the process of continually fixing and maintaining the product so that it continues to work successfully for as long as time as possible.

There are two types of maintenance:

- Proactive – this means carrying out planned maintenance fixing parts before they break.
- Reactive – this means repairing the broken part

Proactive maintenance is preferred as there will be no unplanned stoppages to machines.

Proactive maintenance can include:

- Lubrication – this helps to reduce wear on parts and reduces friction leading to less thermal expansion which in turn can lead to increase wear and parts jamming.
- Avoiding corrosion – corrosion or rusting can slowly wear a part down so parts need to be sprayed with oil or repainted to protect from corrosion. Also regular cleaning of parts to remove chemicals that can cause corrosion.
- Compensating for wear – as parts move they can eventually wear away, so parts that wear are replaced before they break maintaining the machine and keeping it working.

Another method used in proactive maintenance is by using statistics. This involves predicting the life span of a part and replacing it at the end of the life span.



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What does the term Built in Obsolescence mean?

What three types are there?

- 1,
- 2,
- 3,

Explain how one of these types demonstrates Built in Obsolescence

Explain one advantage of Built in Obsolescence

Explain one disadvantage of Built in Obsolescence

What are the two types of Maintenance carried out on Engineering products?

- 1,
- 2,

Explain each type

1,

2,

Which method is better and why

Name and explain the three ways Proactive maintenance can be completed on Engineered products.

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Availability of materials and user requirements

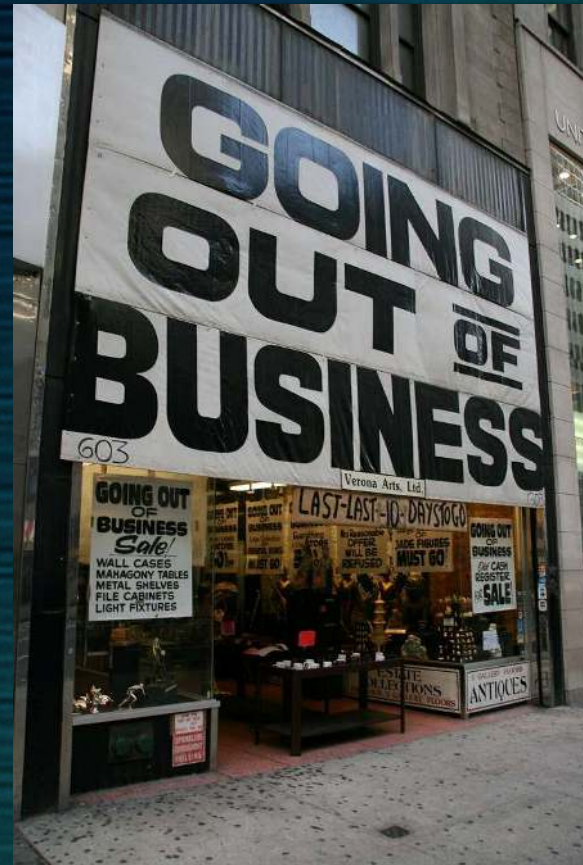
Sometimes the required materials are not available and therefore the engineer has to find alternative ways.

Changes in availability may mean that the materials are not available, this can occur because:

- Supplier goes out of business
- Market forces, demand is high so not enough material available
- Limits on available due to wars or trade restrictions.

This may mean other or non standard forms being used increasing cost of the final product.

Additionally, the end user may also specify additional properties to for fill its requirement such as wanting materials with higher properties or a specific look.



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What three examples are there that could effect the engineers decision making about materials or supplies?

1,

2,

3,

Explain how one of these can effect an engineer

How can engineers get around this issue?

How can the user effect an engineers decision making when designing and making a product?
