

# 1.3 Energy Generation

## Renewable energy resources:

**Biomass** - Organic matter derived from organisms, such as wood, crops, rubbish, landfill gas and alcohol fuels. Can be used directly via combustion (of wood or biodegradable wastes) to produce heat or converted to electricity.

**Biodiesel** - Made from natural elements such as plants, vegetables and fermented waste cooking oil. Can be used in diesel-powered vehicles without modifying the engine.

**Tidal** - Turbines generate electricity from the movement of tidal water. Artificial tidal barrages are constructed across tidal rivers, bays and estuaries, for example – the water is trapped and then released through turbines as the water levels change.

**Wind** - Wind turbines use propeller blades, which spin a shaft to create electricity through a generator.

**Solar** - Solar (photovoltaic - using solar cells to generate electrical power by converting energy from the sun) panels convert sunlight into electricity. Solar thermal power plants use the sun's rays to heat a fluid that is circulated through pipes, transferring heat to water and producing steam. Steam is converted into mechanical energy in a turbine, which powers a generator to produce electricity.

**Hydroelectric** - A dam traps water that flows through tunnels and turns turbines to make electricity.

**Power systems** - A power system is a network of components that supply, transfer and use electric power. These include batteries and cells, solar cells, wind power and mains electricity.

## Non-renewable energy resources:

**Coal** – Heat energy and hot gases convert water into steam which powers a turbine to create high-voltage electricity. Smaller amounts used as a domestic heat source.

**Oil** – Processed and split into petroleum products such as petrol, paraffin and diesel. In power plants oil is burnt to heat water and produce steam, which propels turbine blades to produce electricity

**Gas** – Burning gas can power turbines, with the waste heat powering a steam turbine. Natural gas is used in homes for heating or cooking. It has lower emissions than other fossil fuels – its combustion emits carbon dioxide at half the rate of coal.

On a national grid level the supply of electricity must be equal to demand and power companies make adjustments to the supply based on predictable changes such as the timings of the working day, as well as unexpected changes from equipment overloads and storms. Any electricity not used when created must be stored so that there is more flexible and reliable use.

**Choosing appropriate energy sources for products and power systems:** Here are some examples of factors that designers may need to consider.

**Portability of the power source:** remote working requires access to devices (computers, phones, medical aids) with a power source that does not need to be plugged into mains electricity. Such devices can be portable and compact as they do not need power converters.

**Environmental impact:** no entirely 'clean' energy source exists. The impact may be active, like fossil fuel emissions or the destruction of habitats through extraction. Passive impacts include the sound of generators or the appearance of wind farms. Other environmental factors include the impact of transportation or waste disposal.

**Power output:** a generator's output may vary according to conditions at the power plant, fuel costs or the electric power grid operator. Many renewables do not produce electricity predictably or consistently; for example the output of solar panels relies on the strength of the sunshine, which depends on the time of day and cloud cover. Renewables are therefore often backed up by other forms of electricity generation. A designer must select an electricity supply capable of reliably delivering the required power.

**Circuit/system connections:** when considering alternative power sources, a designer will need to consider how the circuit or system will be connected to it, for example the use of available plugs, connectors and terminals.

**Cost:** the choice of the energy supply, for example batteries or a mains electricity power pack, will impact the running costs of the product and so the costs of alternative power supplies must be considered carefully by a designer.