

# Energy in Society

## What is Energy

- The universe is composed of matter and energy
- Energy is everything without mass
  - i.e. things you cant feel or see

## Energy Types

- Mechanical
- Heat (Thermal)
- Electrical Energy
- Gravitational Potential Energy
- Chemical Energy
- Nuclear Energy
- Solar Energy

## Two Main Types of Energy

- Kinetic
  - Doing energy – movement
- Potential
  - Stored energy – to be converted to Kinetic

## Units of Energy

- The unit of energy is the JOULE (J)
- 1 kilo joule (kJ) = 1000 J
- 1 mega joule (MJ) = 1,000,000 J

## Law of Conservation of Mass

- During a chemical reaction the mass of the reactants is equal to the mass of the products
- The total mass of a chemical reaction does not change

### Law of Conservation of Energy

- When energy is transformed into another kind, the total energy stays the same
- Energy is not lost or gained, its transferred

### Energy During a Chemical Reaction

- During a chemical reaction the chemical energy inside it is released as heat, light and kinetic energy

### Energy Converters

- Convert one form of energy into another form
- The energy is normally transformed into several different kinds

### Combustion of Petrol

- Petrol is mainly composed of OCTANE
- $2C_2H_{18(l)} + 25O_{2(g)} \rightarrow 16CO_{2(g)} + 18H_2O_{(g)}$

### Coal Fired Power Station

- Coal is burnt
  - Chemical energy in coal  $\rightarrow$  thermal energy
- Heat from coal is used to boil water
  - Thermal energy transferred coal  $\rightarrow$  water
- Steam is passed through a turbine
  - Thermal energy  $\rightarrow$  mechanical energy

### Coal Fired Power Station

- Electricity formed from generator driven by turbine
  - Mechanical energy  $\rightarrow$  electrical energy
- Most inefficient transfer of energy occurs in the thermal  $\rightarrow$  mechanical in the turbine
- Overall 30 –40 % efficiency
- Car Engine has 25% efficiency

## How Much Energy Do We Use

- Basic bodily needs is 10MJ / day
- Modern person uses 1000MJ / day
- Bulk is used on
  - Transport
  - Heating
  - Domestic purposes

## Time for Decisions

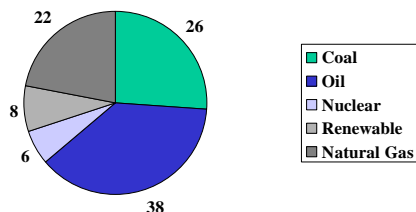
- Current use of energy can NOT be sustained indefinitely
  - Most of our sources of energy are unrenewable
- Many alternative sources of energy are environmentally unsuitable
  - e.g. nuclear

## Time for Decisions

- Must balance the benefits of a new idea with its costs and risks
- Called a Cost – Benefit Analysis
  - Specifies the main alternatives available
  - Estimate the tangible costs and list the intangible costs of each alternative
  - Compare the costs with the benefits
  - Choose the option where the benefits most out way the costs

# Energy Sources

## Sources of energy available to society today



## Renewable Energy Sources

## Fossil Fuels

- These include coal, oil and natural gas
- Formed from primitive plants and animals
- Underwent complex changes over millions of years
- Chemical energy is trapped

## Coal

- A mixture of large molecules made from C, H, N, S and other elements
- Molecular Weight can be about 3000
- As coal forms C content  $\uparrow$  & O content  $\downarrow$
- Amount of water decreases as this occurs
- Less water content = more energy released

## Coal

- Black coal although harder to extract is more desirable
- Reaction of coal burning
- $C_{(s)} + O_{2(g)} \rightarrow CO_{2(g)}$
- The chemical energy in coal is converted into electrical energy in a power station

## Oil

- Crude oil is a mixture of hydrocarbons (alkanes)
- Must be processed to be useful (fractional distillation)
- Relative amounts of alkanes vary according to location of reserve (Bass Straight oil is low on large molecules)

## Oil

- Liquefied Petroleum Gas (LPG) is replacing petrol as fuel in vehicles
- LPG is a mixture of propane and butane
- Down sides of LPG
  - Need for large fuel tanks reducing cargo space
  - Cost of engine conversion
- LPG  $\frac{1}{2}$  price of Petrol to attract conversion

## Natural Gas

- Mainly methane ( $CH_4$ )
- Small amounts of other hydrocarbons
  - Ethane ( $C_2H_6$ ) and propane ( $C_3H_8$ )
- Popular fuel for heating and cooking
- Reserves limited

## Concerns for Use of Fossil Fuels

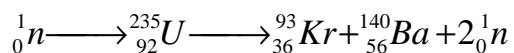
- Fossil fuels used as raw materials for many products in chemical industry
  - e.g pharmaceuticals, plastics, fibres
- Fossil fuels release carbon dioxide contributing to greenhouse
- Sulfur is present in fossil fuels and when burnt produces sulfur dioxide
  - This forms sulfuric acid within days

## Nuclear Energy

- Large quantities of heat are released when Uranium 235 is bombarded by neutrons
- The nucleus is split in this reaction
- Two new elements are produced
- The two neutrons produced go onto to collide with more uranium atoms causing a chain reaction

## Nuclear Fission and Fusion

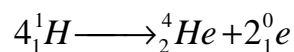
- Fission is when a large atom is broken down into smaller atoms



- The heat generated is used in a power station
- 1 kg of uranium produces the same energy as 2500 tonne of coal

## Nuclear Fusion

- Fusion is when two smaller atoms join to make a larger atom



- Occurs in the sun and in Hydrogen Bomb
- Not suitable for a power station

## Renewable Energy Sources

- Resources that are constantly replaced

## Solar Energy

- Technically fossil fuel is created from solar energy
- More directly, its used for heating, particularly hot water
- Also for heating swimming pools
- Used for generating electricity

## Electricity from Solar Power

- Done by solar cells
- DISADVANTAGES
  - Expensive
  - Less effective in cloudy weather
  - Large area of land required with respect to electricity generated

## Hydro Electricity

- Uses the energy of falling water to spin the turbines
- Disadvantages
  - Limited number of suitable sites
  - Environmental concerns with dam building

## Wind Power

- Needs a constant and fairly strong wind source
- Disadvantages
  - Turbines are highly visible
  - Moving blades create some noise
  - Electricity production depends on wind speeds
  - Large number of turbines needed

## Tidal Power

- Depends on the rise and fall of water in response to gravitational pull of moon and sun. Need a large difference
- Operates at night
- Disadvantages
  - Tidal power is not constant
  - Depends on monthly lunar cycles

## Geothermal Power

- Volcanic action may cause super hot steam to rise to surface.
- Restricted to suitable areas

## Conservation

- We can extend our non renewable energy sources two ways
  1. Develop alternative energy sources to produce more energy
  2. Conserve our existing energy reserves by using less energy

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