

Energy, its Impacts to Environment, and Energy Efficiency Concept and fundamentals

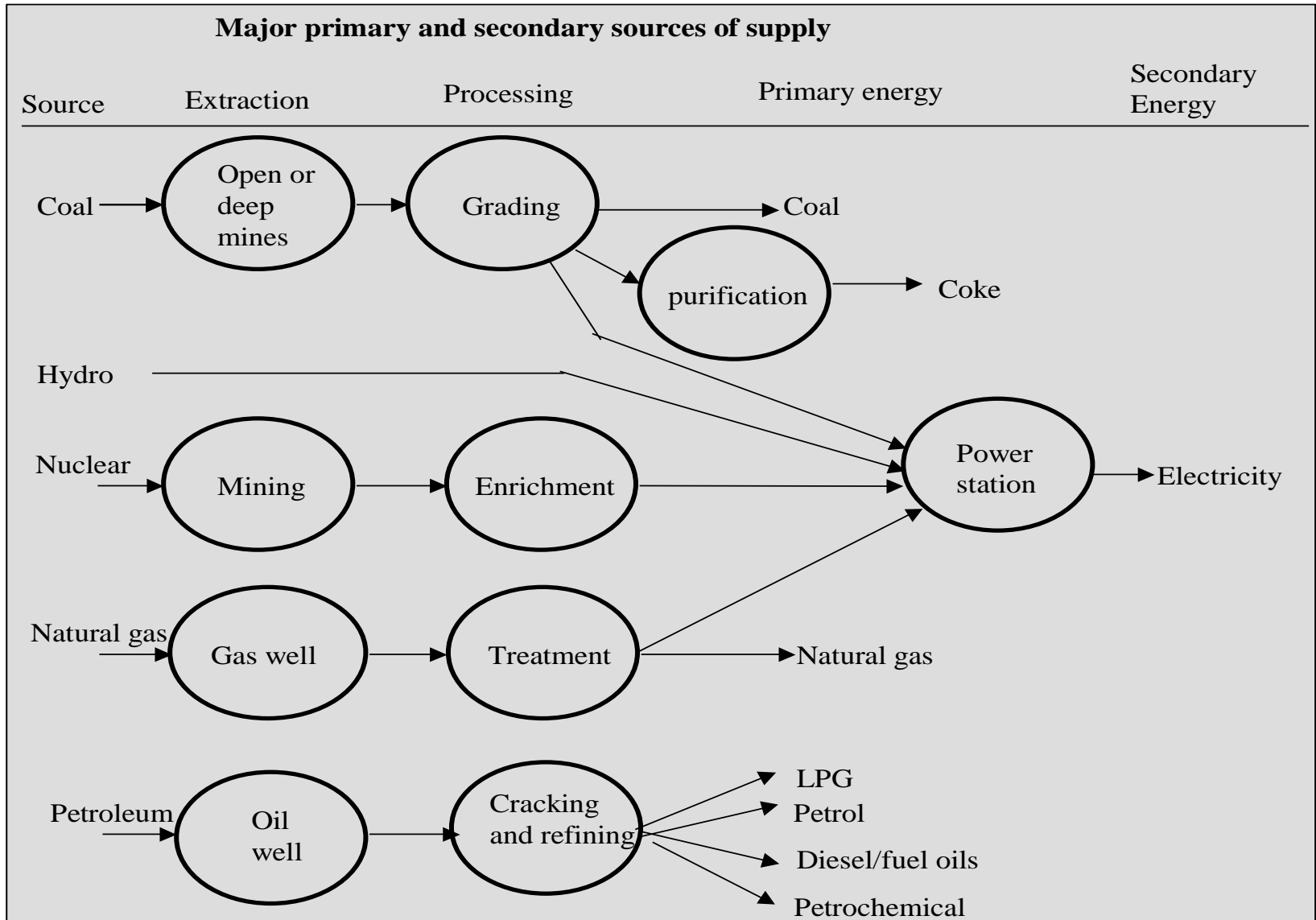
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What is Energy

- Energy is basically the capacity of a body to do work. The different forms of energy are: Mechanical energy, Thermal (or) Heat energy, Chemical energy, Electrical energy, Nuclear energy, Electromagnetic energy, Gravitational energy.

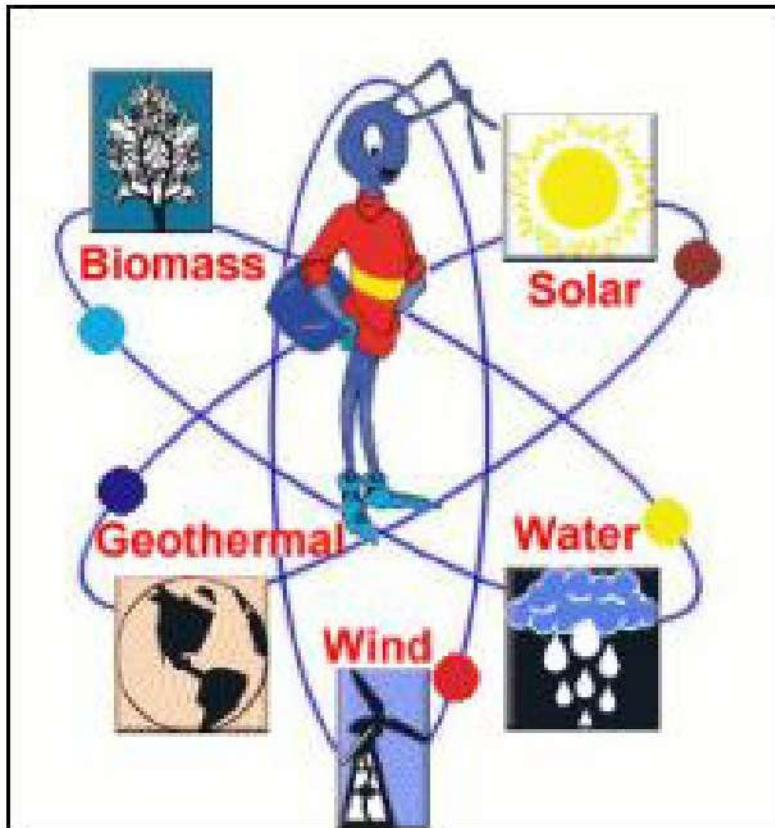
Energy: Classify by sources

Primary Energy & Secondary Energy

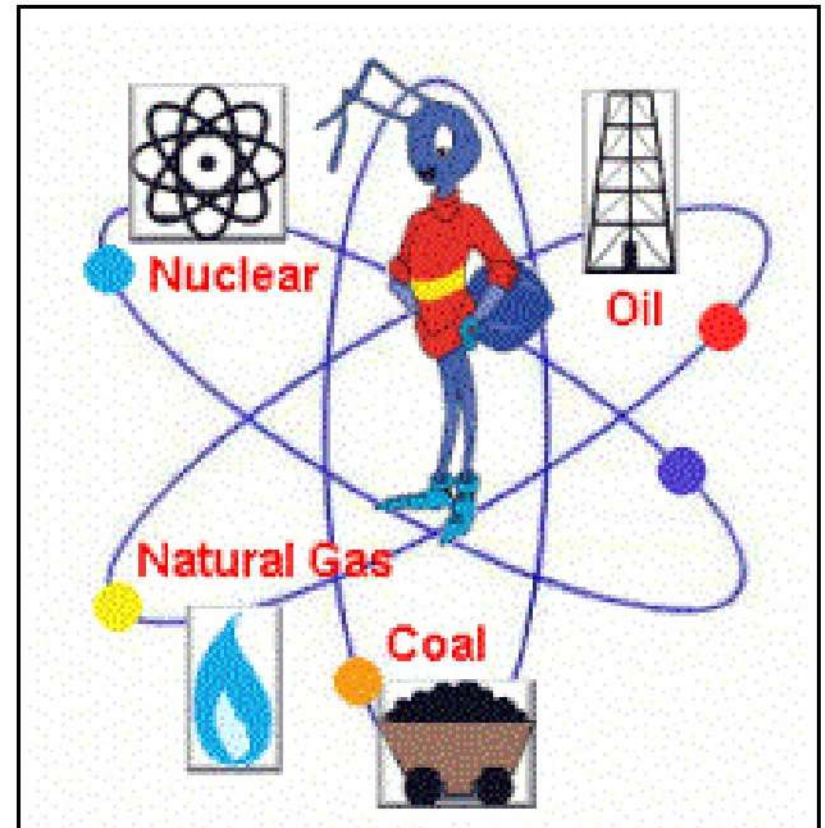


Energy: Classify by sources used

Renewable Energy



Non-Renewable Energy



Significance of renewable energy



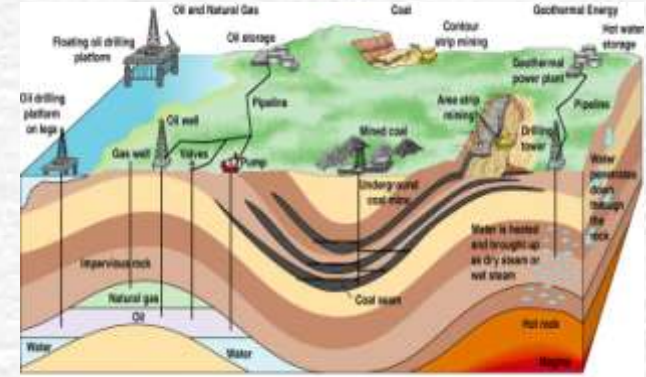
- **Clean energy. Harmless to the environment**
- **Unlimited and reusable**
- **Raise Employed and good economy system**

Energy: Classify by production

Conventional and Non-Conventional Energy

Conventional energy sources

include fossil fuel energy and nuclear energy. It is a non renewable source of energy.



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Non conventional energy

sources include wind energy, tidal energy, solar energy, bio energy & fuel cell energy. It is renewable source of energy.

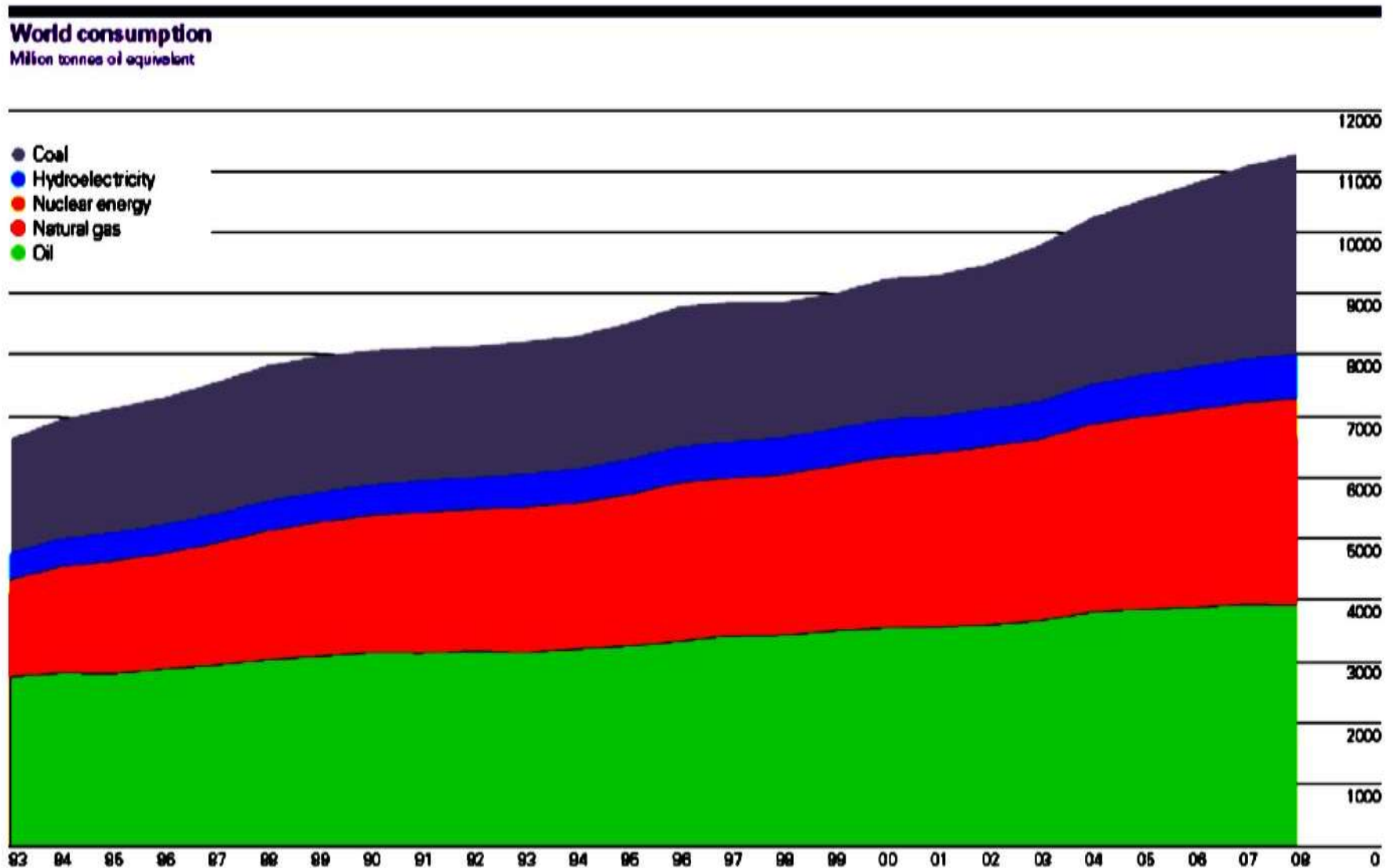


Energy:

Commercial and Non-Commercial Energy

- **Commercial Energy** is energy available at price, and industrial production.
 - Examples are electricity, coal, lignite, oil, and natural gas
- **Non-Commercial Energy** is energy not available in market for a price, and household production.
 - Examples are firewood, cattle dung and agricultural waste solar energy, animal power, wind energy.

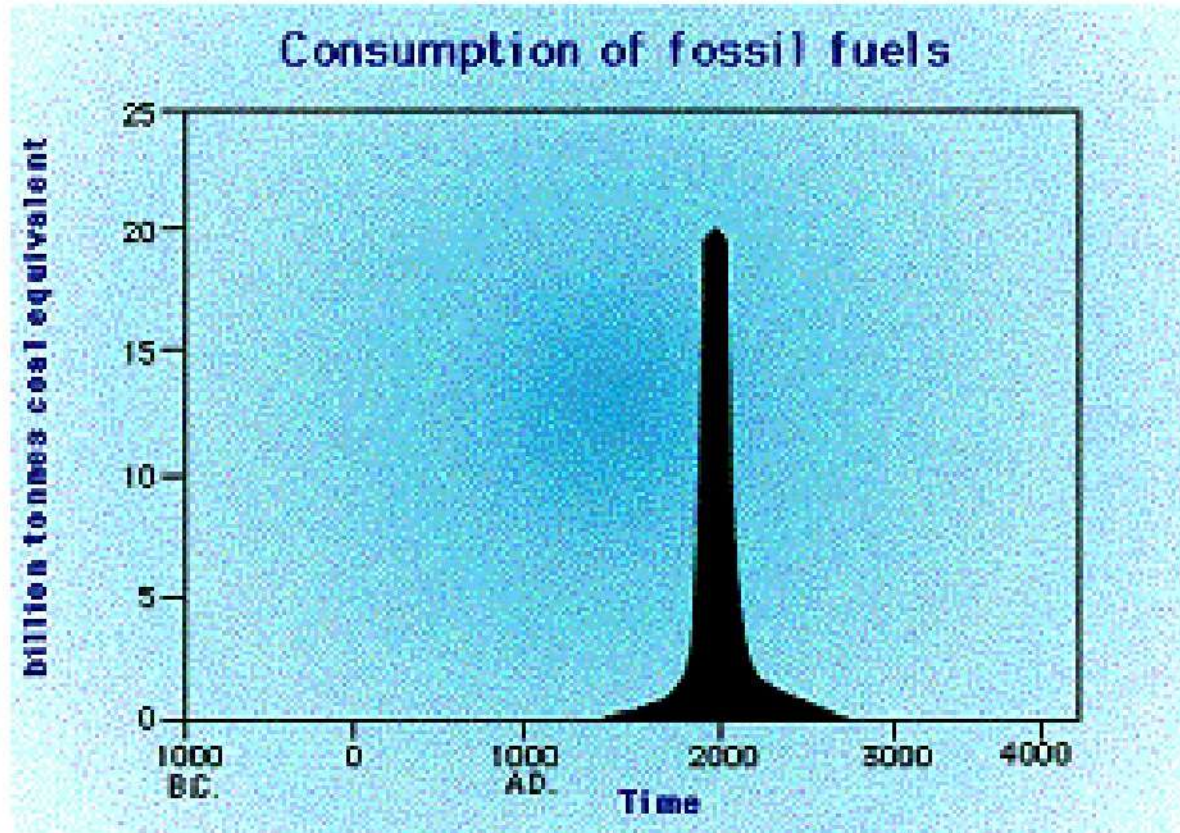
Global Primary Energy Consumption



World Energy Consumption

60% of world Resources consumed so far

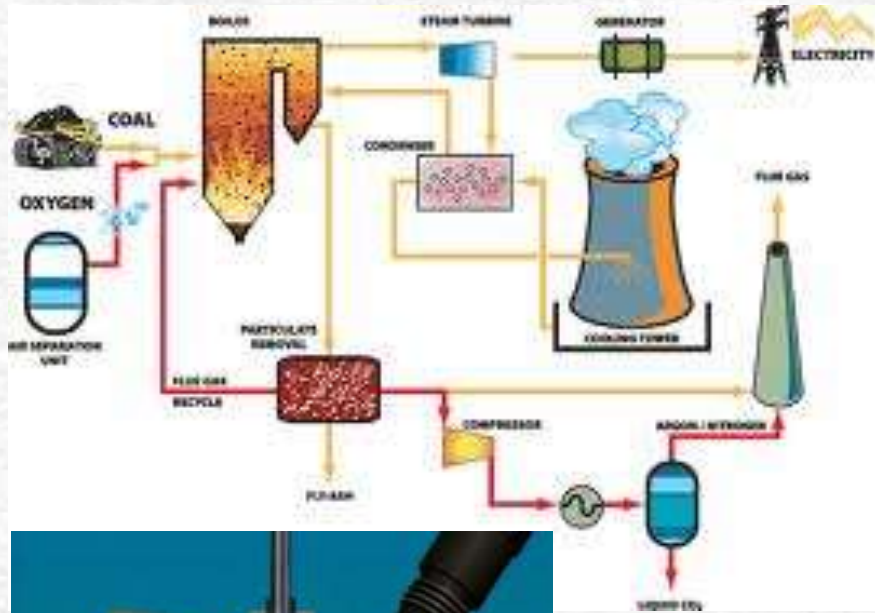
85% of raw energy comes from non-renewable sources and hence not available for Future generation



Remaining resource of the world

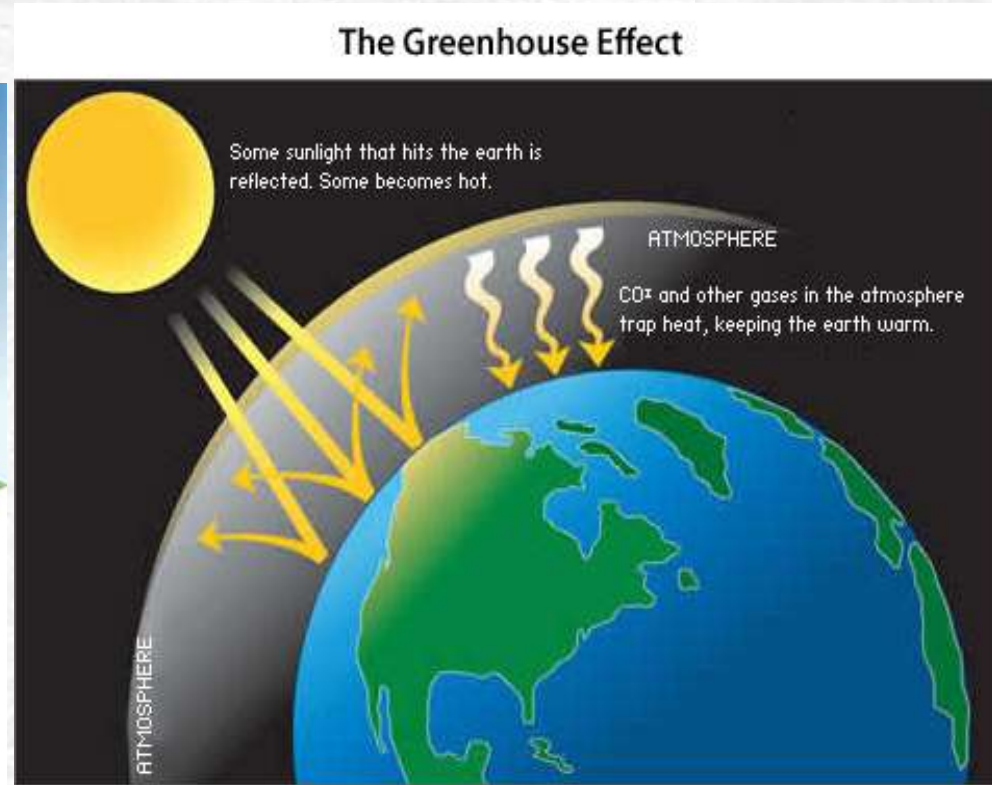
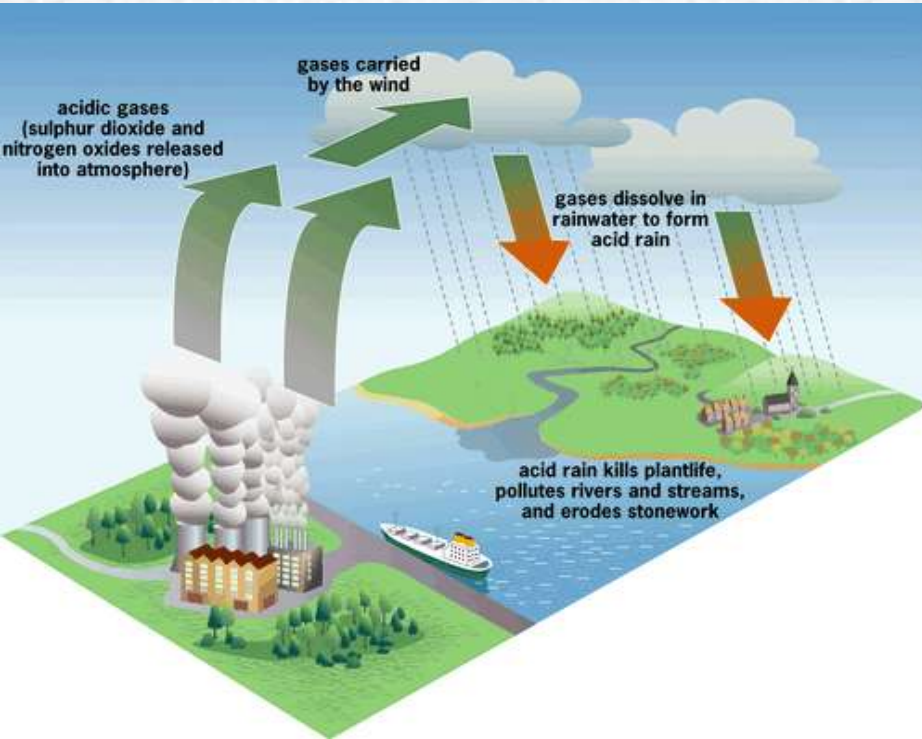
	Crude oil	Petroleum gas	Coal	Uranium
Total remaining	1.46 Mill. Mill. Barrel	150 Mill. Mill. m ³	984.2 Th. Mill. Tons	3.95 Mill. Tons
Production per year	26.2 Th. Mill. Barrel	2.4 Mill. Mill. m ³	4.34 Th. Mill. Tons	35 Th. Tons
Enough to use for	40 Years	61 Years	227 Years	64 Years

Impact of Energy Consumption on Environment



Carbon Dioxide gas can be produced from combustion process is greenhouse gases

Impact of Energy Consumption on Environment



Greenhouse gases

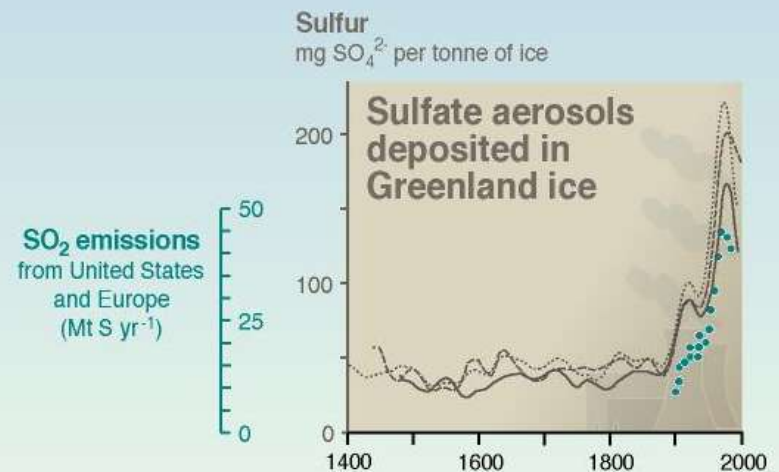
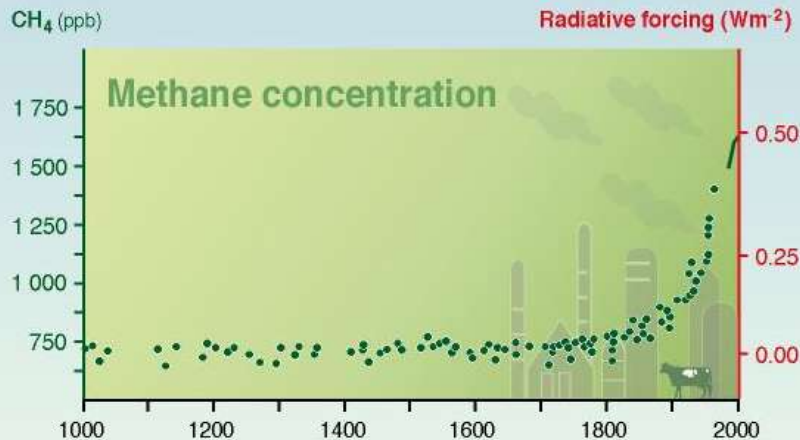
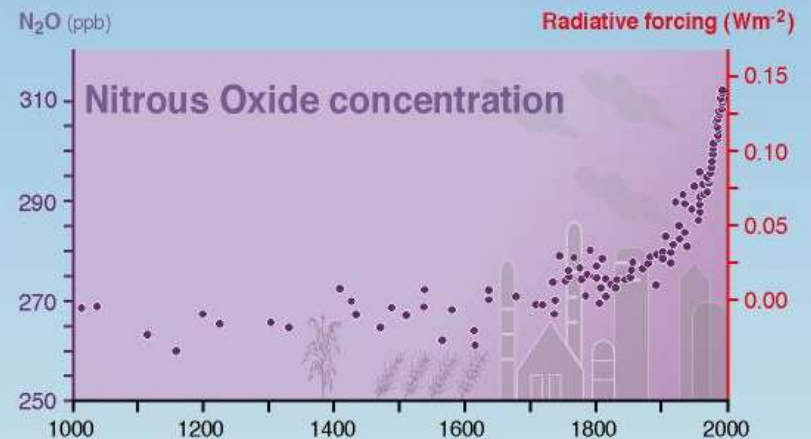
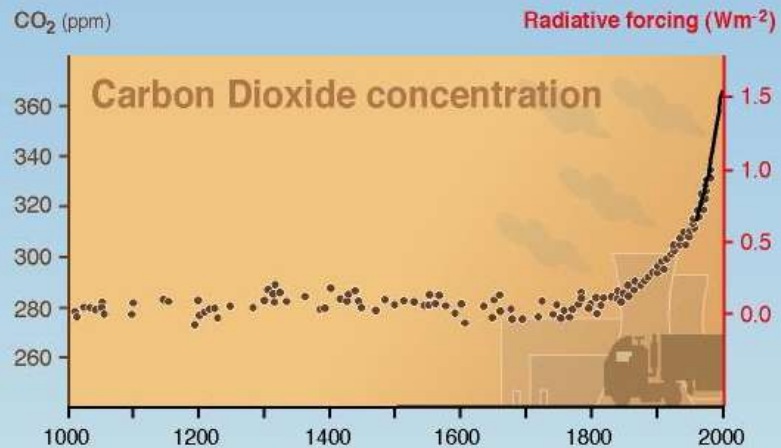
- Carbon Dioxide, Methane, Nitrous Oxide, Chlorofluorocarbons (CFCs), Ozone



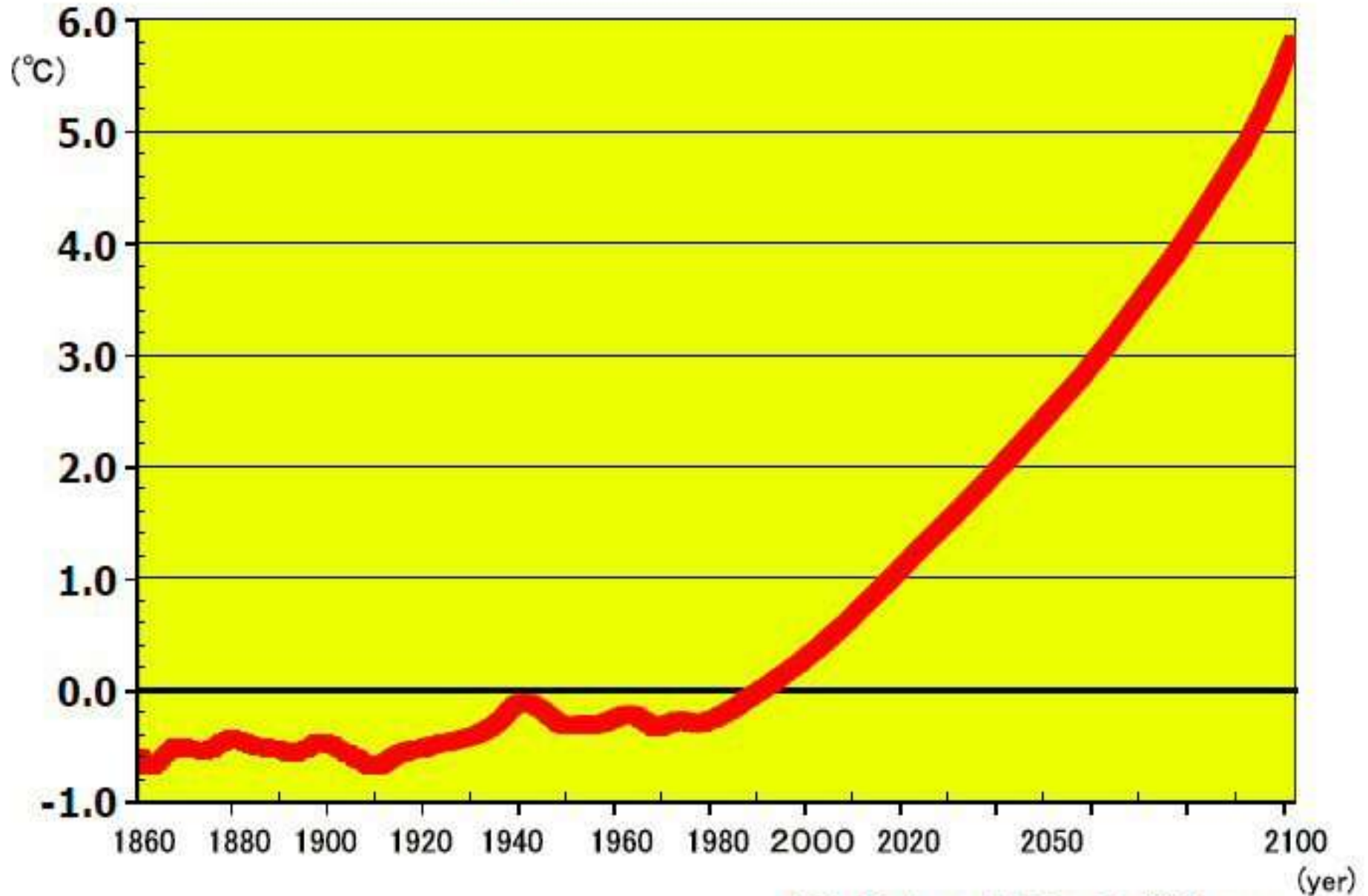
The effect is increasing temperatures on Earth

CLIMATE CHANGE

Greenhouse gases are increasing...



Projection of Average Temperature Rise of Earth (IPCC)

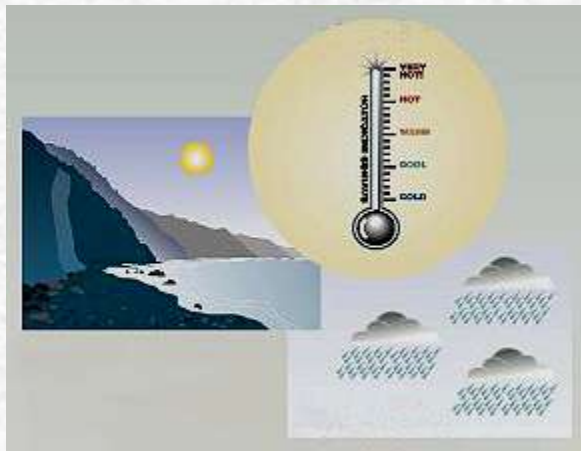


(C) Network Earth Village

CLIMATE CHANGE

Less visual but with major impact

Consequences of climate change:



- > Temperature increase
- > Sea level rise
- > More rain



Agriculture and food security

Crop yields, irrigation demands...



Forest

Composition, health and productivity...



Water resources

Water supply, water quality...



Coastal areas

Erosion, inundation, cost of prevention...



Species and natural areas

Biodiversity, modification of ecosystems...



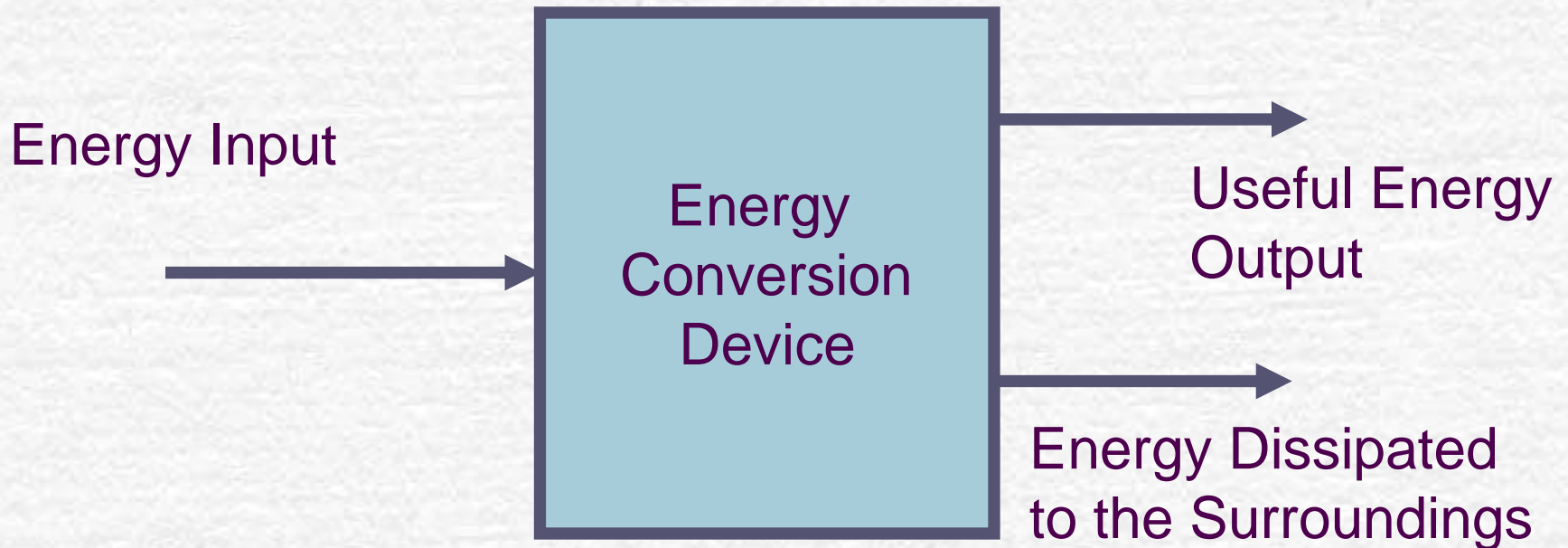
Human health

Infectious diseases, human settlements...

Why Energy Efficiency?

- ☛ Three top operating expenses are energy (both electrical and thermal), labour and materials;
- ☛ Energy would emerge as a top ranker for cost reduction;
- ☛ If we are more efficient with the energy, we already have there will be less pollution, less reliance on foreign oil and increased domestic security;
- ☛ Continue increasing of energy pricing;
- ☛ Energy security.

Energy Efficiency

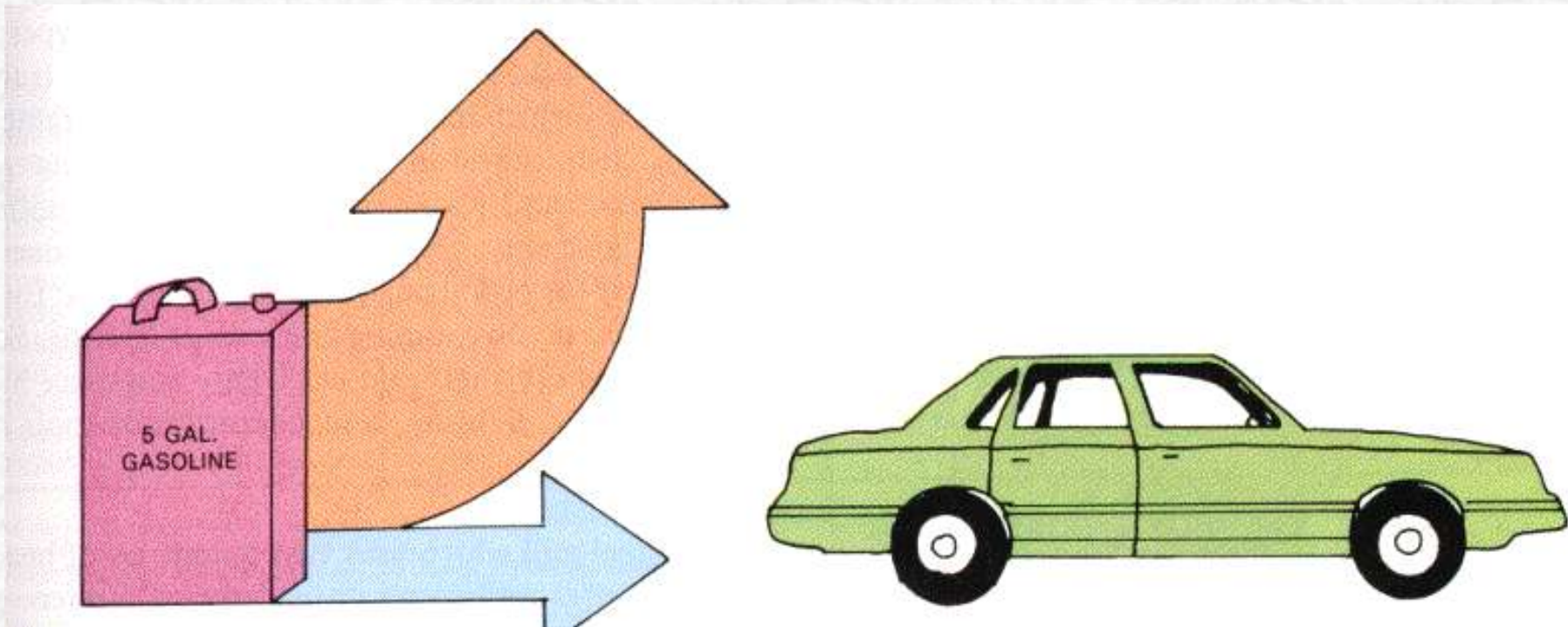


$$\text{Efficiency} = \frac{\text{Useful Energy Output}}{\text{Total Energy Input}}$$

Efficiency of Some Common Devices

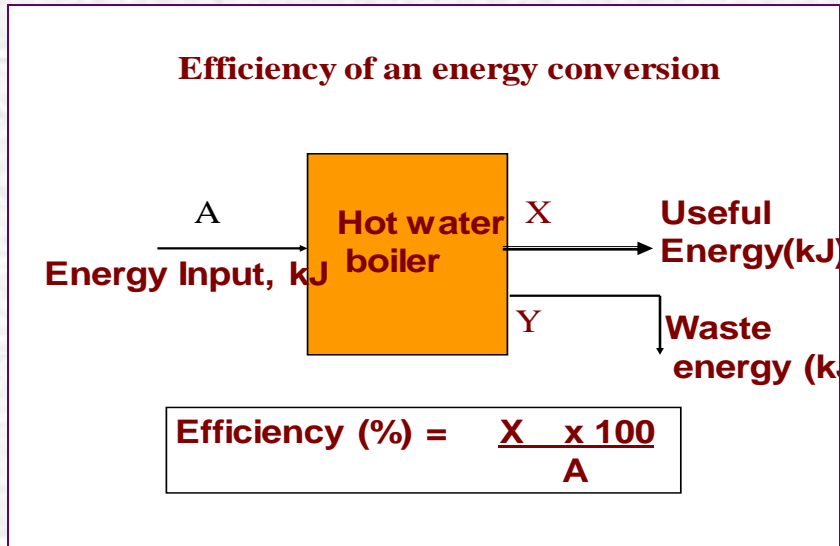
Device	Efficiency
Electric Motor	90
Home Oil Furnace	65
Home Coal Furnace	55
Steam Boiler (power plant)	89
Power Plant (thermal)	36
Automobile Engine	25
Light Bulb-Fluorescent	20
Light Bulb -Incandescent	5

Vehicle Efficiency – Gasoline Engine



25% Of the gasoline is used to propel a car, the rest is “lost” as heat. i.e an efficiency of 0.25

What is Energy Efficiency?



Conversion	Example	Efficiency (%)
Chemical heat to	Gas water boiler	70-90
Electrical to mechanical	Electric motor	70-90
Heat to mechanical	Steam turbine	45

- Portion of Energy which ends up doing useful work
- Energy efficiency means using less energy to perform the same function.
- Example: Replacing traditional light bulbs with Compact Fluorescent Lamps (CFLs) means you will use only 1/5th of the energy to light a room

Energy Conservation vs Energy Efficiency

Energy Efficiency uses less energy for same output and reduces CO₂ emissions



Incandescent Lamp
100 W

CO₂ Emission – 110 g/hr



Compact fluorescent Lamp
18W

CO₂ Emission – 20 g/hr

Energy transformation & energy conversion efficiency

Oil generate heat -->

Heat boils water -->

Water turns to steam -->

Steam pressure turns a turbine -->

Turbine turns an electric generator -->

Generator produces electricity -->

Electricity powers light bulbs -->

Light bulbs give off light and heat

More the number
of conversion
stages, lesser the
energy efficiency

Understanding energy costs

Typical summary of energy bill by a company

Type of energy	Original Unit	Unit Cost	Monthly bill	Equivalent cost US\$
Electricity	350,000 kWh	Kip 700/kWh	245,000,000	30,625
Fuel Oil	100 kl	Kip 6,000,000/kl	600,000,000	75,000
Coal	1,000 tons	Kip 300,000/ton	300,000,000	37,500
		Total:	1,145,000,000	143,125

Electricity (1 kWh)

= 860 kcal/kWh (3600 kJ)

Heavy fuel oil (calorific value, GCV)

=10000 kcal/litre (42000 kJ/litre)

Coal (calorific value, GCV)

=4000 kcal/kg (18*10⁶ kJ/ton)

1 kcal = 4.187 KJ

Energy Conservation Opportunities

- Energy distribution
- Energy generation
- Energy usage by processes
- Fuel substitution

Maximizing system efficiency

- Eliminate steam leakages by trap improvements
- Maximize condensate recovery;
- Adopt combustion controls for maximizing combustion efficiency;
- Replace pumps, fans, air compressors, refrigeration compressors, boilers, furnaces, heaters and other energy conservation equipment, wherever significant energy efficiency margins exist.

Matching Energy Usage to Requirement

- Mismatch between equipment capacity and user requirement often leads to inefficiencies due to part load operations, wastages etc
- Examples :
 - Eliminate throttling
 - Eliminate damper operations
 - Fan resizing for better efficiency.
 - Moderation of chilled water temperature for process chilling needs

Optimizing Input Energy Requirement

- ✓ Shuffling of compressors to match needs.
- ✓ Periodic review of insulation thickness
- ✓ Identify potential for heat exchanger networking and process integration.
- ✓ Optimization of transformer operation with respect to load

Fuel and Energy Substitution

Fuel substitution

- Natural gas is increasingly the fuel of choice as fuel and feedstock in the fertilizer, petrochemicals, power and sponge iron industries.
- Replacement of coal by coconut shells, rice husk, etc
- Replacement of fuel oil by CNG or other fuel.

Energy substitution

- Replacement of electric heaters by steam heaters
- Replacement of steam based hot water by solar systems

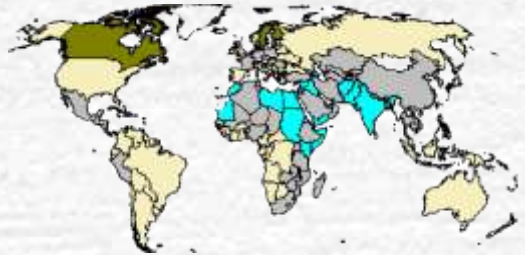
EE Benefits

Industry



- Reduced energy bills
- Increased Competitiveness
- Increased productivity
- Improved quality
- Increased profits!

Nation



- Reduced energy imports
- Avoided costs can be used for poverty reduction
- Conservation of limited resources
- Improved energy security

Globe



- Reduced GHG and other emissions
- Maintains a sustainable environment