Energy Systems - Non Renewable

Actual and Potential Environmental Impacts on Alternative Energy Systems

Energy System	Air Pollution	Water Pollution	Land disruption	Possible Large Scale Disasters
Fossil Fuels				
• Petroleum • Advantages & Disadvantages	Suphfur Dioxide, nitrogen oxides and hydrocarbons, global climate change from carbon dioxide.	Oil spills from blowouts, tanker accidents, pipeline ruptures	Subsidence, estuary pollution	Massive spills on water from tanker accidents and offshore well blowouts, massive spills on land from pipeline breaks, refinery fires.
• Natural Gas • Advantages & Disadvantages	Global climate change from carbon dioxide	Excess heat	Subsidence	Pipeline explosions, liquefied natural gas (LNG) tanker explosions
• Coal • Advantages & Disadvantages	Sulphur dioxide, particulates (see note below) , nitrogen oxides, global climate change from carbon dioxide, radioactive emmissions.	Acid mine drainage,acid rain, dissolved solids from washing coal, excess heat.	Undeground and strip mining, subsidence, slag disposal, erosion.	Mine accidents, landslides, sudden subsidence in urban areas, depletion and contamination of water resources in arid regions.
• Oil shale • Advantages & Disadvantages	Sulphur oxides, particulates, hydrogen sulphide, nitrogen oxides, hydrocarbons, global climate change form carbon dioxide, odour	Dissolved solids (salinity) and heavy metals from processed shale rock, sediment, ground water contamination	Disposal of processed shale rock, subsidence.	Depletion and contamination of water supplies in arid regions where most shale is found, massive oil spills from pipeline breaks, earthquakes depending on underground processing, depletion and contamination of water resources in arid regions.
• Tar sands • Adavantages & Disadvantages	Sulphur oxides, hydrogen sulphide, hydrocarbons. nitrogen oxides, global climate change from carbon dioxide.	Possible contamination of underground water supplies if extracted and processed underground.	Surface mining, subsidence, loss of wildlife habitat.	Massive oil spills from pipeline breaks, earthquakes depending on underground extraction method, depletion and contamination of water resources in arid regions.
Nuclear Energy				
• Conventional Fission • Advantages & Disadvantages	Radioactive emmissions	Radioactive mine wastes, excess heat, radio effluents	Open pit and underground mining, storage of radioactive wastes.	Release of radioactive material from meltdown of reactor core, sabotage.
• Breeder Fission • Advantages & Disadvantages	Radioactive emmissions	Fewer radioactive mine wastes, excess heat, radio effluents	Open pit and underground mining, storage of radioactive wastes.	Same as above but radioactive release more dangerous.
• Fusion • Advantages & Disadvantages	Radioactive emmissions	Excess heat		Release of radioactive materials from meltdown or explosion of reactor.
Geothermal Energy • **Advantages & Disadvantages**	Hydrogen sulphide and ammonia, global climate change from carbon dioxide, radioactive materials, noise, local climate change, odour	Salinity (dissolved solids), boron runoff, excess heat.	Subsidence	Depletion and contamination of water resources in arid regions.

Fossil Fuels	Fossil fuels form from the decay of living matter deep beneath the earth's surface over many thousands of years. In many cases it is found to be captured where an impervious layer (similar to clay) has not allowed the escape of any of the fossil fuels to reach the earth's crust. Decaying matter becomes water, oil and gas with density deciding the order of the three. Water being the densest at the bottom with oil above and gas on the top. It is the penetration of the impervious layer that has allowed mankind to collect these fuels.
Petroleum	Petroleum is made from crude oil. Crude oil is a dark breeny brown colour, extremely pugnent and contains a complex mixture of hydrocarbons, with sulphur, oxygen and nitrogen compounds present in the combined compound. Low sulphur content is preferred in the refining of crude oil as high sulphur content leads to sulphur dioxide becoming acid rain.
Natural Gas	Consists of 50 to 90% methane. Methane is a hydrocarbon compound consisting of hydrogen and carbon (CH_4) and small amounts of more complex hydrocarbon compounds like propane (C_3H_8) and butane (C_4H_{10}).
Coal	Coal is a solid containing between 55 to 90% of carbon. Like crude oil it is formed deep below the earth's surface. It also contains small amounts of hydrogen, sulphur, oxygen and nitrogen but over the millions of years it takes to form becomes richer in carbon content and changes from low coal grade (brown coal) to a high quality coal capable of producing a greater proportion of energy than the low grade comparing equal cubic measure.
Oil Shale	Rock containing solid hydrocarbons that can be distilled out to yield an oil-like material called shale oil. It is an underground formation of marlstone sedimentary rock containing varying amounts of rubbery solid mixture of hydrocarbons known as kerogen. Kerogen is mined in a similar way to coal - either strip mining or deep. The rock is then sent to a processing plant where it is crushed and then heated to about 460°C. This process vaporises the kerogen which is then condensed to form a viscous dark brown fluid called shale oil.
Tar Sands	Tar Sands are gained from large swamps of fine clay, sand and water mixed with black, thick molasses sulphur like tar known as bitument which is about 80% carbon. Shallow deposits are strip mind and then heated with steam to make viscous tar flow and float to the top. The extracted heavy oil usually containing large amounts of sulphur,has to be then upgraded to synthetic crude oil and have the sulphur removed.
Nuclear Energy	
Conventional Fission	Fission occurs inside a reactor that acts in a similar way to a firebox in a fossil fuel power plant. Inside the reactor energy is released by the process of nuclear fussion in which the nucleus of a heavy atom (eg uranium) is split apart by a slow moving neutron into lighter fission fragments plus two or three neutrons. Slowed by passing through a moderator (eg graphite or water) these neutrons split other uranium nuclei releasing more energy and more neutrons.If controlled this leads to a chaiun reaction where more energy is released. The fission rate is controlled by moving neutron absorbing rods (eg cadmium) back and forth in the fuel core. A coolant (eg water, heavy water, gas or a liquid metal [eg sodium]) is then passed through the reactor to absorb heat. The heat is used to convert water into superheated steam. This steam turns the blades of a turbine.
Breeder Fission	Breeder Fission was researched on the off chance that supplies of uranium world wide would become scarce. Breeder Fission also requires a reactor and works in a similar way to Fission but has as its fuel a mixture of uranium and plutonium and liquid sodium as a coolant.
Fusion	Nuclear fusion is gained by the forcing of two nuclei of light, nonradioactive atoms (eg hydrogen) together at ultrahigh temperatures to form a heavier nucleus (eg helium) releasing energy in the form of fast neutrons. Fusion relaeases four times as much energy per gram as fission and about ten million times as much as the combustion of fossil fuel.
Geothermal Energy	
	Geothermal energy is gained when rocks deep below the earth's surface are heated to high temperatures by energy: ▪ from the decay of radioactive elements in the earth or ▪ by molten magma penetrating its way towards the surface. The magma if trapped beneath the earth's surface heats other rocks near the surface to form geothermal reservoirs. The resulting heat energy may remain trapped in hot rocks or be transferred to underground water and form hot water or steam. Natural crevices or drilled geothermal wells then bring the steam to the surface where it is used on site to turn the blades of a turbine to produce electricity. If insufficient steam is released scientists can force water down the well to have it return as steam in a similar way as water is pumped from a bore.