

Non-renewable energy resources

1. What are nonrenewable resources.

Fossil Fuels: Coal, Oil, Nat'l gas (CH₄)

Metallic Minerals: contain Fe, Al, Cu, Pb, Zn, Ni, Ag, Au, Ti, Hg, Cr, Mn, Mg, Moly, Ur,

Nonmetallic resources:

(chemicals) NaCl, S, Fl, Borax,

(Fertilizers) phosphate, potash, CaCO₃, NaNO₃

(Building) gypsum, calcite, clay, sand, gravel, asbestos,

(Ceramics, abrasives) clay, feldspar, qtz, diamond

*Not renewable on the human time scale, but renewable in the LONG run

Mineral: element or inorganic compound occurring naturally and is in the solid state.

Ore: geologic processes have concentrated minerals and they are economical to extract.

Geologic Processes

2. Earth processes and structure of the earth

Core, mantle and crust- 10 km (oceans) 25-50 km (continents)

Plate Tectonics: dynamic, driven by heat

Tectonic processes

Boundaries: Mid-Ocean Ridges, divergent

- Subduction Zones, convergent plates
- Faults: earthquakes
- (*Hot Spots: Hawaii, Yellowstone, Iceland)

Types of Rocks & where do they occur: the **rock cycle**

- Igneous: Intrusive & Extrusive
- Sedimentary: water & wind deposit rocks or chemicals
- Metamorphic: high temp & pressure, chemical
- (slate, marble, anthracite)

- Weathering and sedimentation
- Geologic Hazards

3. Origin of Nonrenewable resources

*Where do you find them & how do they get concentrated.

COAL: fresh water, plants, greater than 40% organic matter

- -accumulate where plants grow-swamps
- -know this because of gradation from peat to coal
- -Ireland peat
- -no oxygen to decompose organics, acid kills bacteria
- -peat is buried, heated, & water squeezed out
- -found in ancient subsiding basins & continental margins

PETROLEUM: in marine strata (rocks) plants and animals

- -up to 8% organic
- -acc. on continental shelf and slope
- -organics are buried
- -deep burial provides heat and pressure
- -droplets of oil and gas bubbles are produced
- -compaction of sediment and migration of oil to permeable layers

**Long complex process, many reserves are from the Cretaceous*

ORIGIN OF MINERAL DEPOSITS

1. concentrated within magma, partial melting (metals)
- ** 2. deposition from hot, watery solutions (MOR, Hot Spots, geothermal, volcanic, plutons-veins (metals)
3. Deposition from water: precipitates, salts,
 -(Mn Nodules, Glomar Explorers, covers 20% of ocean floor (Mn, Cu, Ni)
 high grade ores at 4,000 m, who gets them?
4. concentration through weathering with groundwater (metals)
5. mechanical concentration in flowing water or wind
 placer deposits, sands, gravels

4. Extracting and Processing Nonrenewable Resources.

Mining

- Surface Mining: coal & some minerals
(strip mining, remove overburden, open-pit)
- Dredging: gold, gravels
- Subsurface: coal & minerals/shafts & explosives
- Hydraulic mining

*Harmful effects of resource extraction,

- -mining is one of the most environmentally damaging activities
- -6x the solid waste of cities (tailings)
- -an area the size of Indiana is abandoned & left unrestored as a result of surface mining
- -acid mine drainage: bacteria produces sulfuric acid from iron sulfide minerals
- -subsurface mining is dangerous (disabled > 1 million killed more than 100,000 injured)
- -ground subsidence
- *Takes a lot of energy to process ore
- -smelting produces lots of waste
- Heap leaching (cyanide)

Mining usually continues until the resource is *economically depleted*

*U.S. is the biggest producer and consumer of nonfuel minerals and we still must import 25%

**Land reclamation*

Oil Production

- -Primary recovery: drill & pump
- -Secondary recovery: water injected (1° & 2° removes 1/3 of oil)
- -Tertiary: steam injected
- -Distillation process (sorts out hydrocarbons by # of Carbons)
- -wide variety of petrochemicals (pesticides, plastics, paints, medicines)

Natural Gas

- -Often associated with oil
- -Liquefied petroleum gas (LPG) & Liquefied Natural gas (LNG)

5. Where are the reserves?

OIL 2/3 in Middle East (Saudi Arabia, Kuwait, Iran, Iraq)
 Mexico is 6th in reserves
 U.S. 4% of reserves, uses 30% of oil extracted

NATURAL GAS 40% in CIS, Iran, U.S,

COAL CIS, China, U.S.

6. How to increase supplies.

OIL -tertiary processing
 -process oil shale & tar sand
 -more exploration (Alaskan Wildlife Refuge)
 -the deep sea

GAS -produce methane

COAL & MINERALS more mining

**Reduce, reuse & recycle

7. Substitutes

Synfuels: low net useful energy, expensive, high environmental cost

-coal gasification

-coal liquification

Hydrogen energy

Ceramics, polymers, plastics, fiberglass

Biofuels

Fuel cells

8. Pros & Cons of the major nonrenewable energy resources.

OIL -high net useful energy
 -versatile
 -easy to transport
 -depleted in 35 years
 -releases CO₂, Sulfur and nitrous oxides
 -oil spills

*If all harmful environmental effects were included it would be too expensive to use, if subsidies were removed.

NATURAL GAS

- cleanest fossil fuel, no particulate matter
- lower net useful energy
- 1/2 CO₂ of coal
- good source for electricity
- LNG is explosive
- good transition fuel for the future (Hydrogen)

* A lot is burned and wasted during extraction

COAL

- most abundant fossil fuel
- most environmentally damaging fossils fuel
(acid rain, land degradation, habitat destruction)
- expensive to transport (no pipelines)

9. **Nuclear Energy:** to reduce the dependence on foreign oil

Nuclear Fission: splitting of U-235

Price-Anderson Act (1957): limits liability to \$7 billion

without it the nuclear industry could have never developed

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|------|--|
| Pros | <ul style="list-style-type: none"> -less surface mining and lower fuel transportation cost and impacts than coal -doesn't contribute to greenhouse effect of acid rain -Breeder Reactors: convert U-235 to plutonium to fuel other reactors |
| Cons | <ul style="list-style-type: none"> -Safety risks: human error, terrorism, sabotage -Three Mile Island -Chernobyl -Waste Disposal (240,000 years to store waste) -Most expensive energy source today -Linked to proliferation of nuclear weapons (Iran) -Nuclear Clean-up cost 250-315 billion dollars |

10. Energy & Resource Strategy, Past, Present and future.

- Mining Law of 1872: encourages mineral extraction on public land almost free of charge
- -buy land at \$2.50 - 5.00/acre and spend \$500 to improve the land for mineral development
- -owners extract minerals and pay no royalties
- owners can ravage the land and gov't ends up with the clean up bill
- -they can sell land for lots of money

Future recommendations

- improved efficiency
- decrease dependence on one source
- find alternative sources:
 - Fuel cell technology/hybrid cars
 - Solar power”
 - Passive (heat)
 - Active: photovoltaic cells
 - Biomass: wood, dung, methane
 - Hydropower (water)
 - Wind
 - Geothermal, tidal, waves

We are in a transition time regarding our use of fuels. Environmental, political and economic forces are driving the More Developed Countries to finally explore alternative fuels in a more serious way!