

ENERGY AND FUELS

Chapter 4

pp. 49 – 54 [Fossil Fuels]

pp. 60 – 66

[Other Possible Sources of Energy]

Dr. Hatem Alsyouri

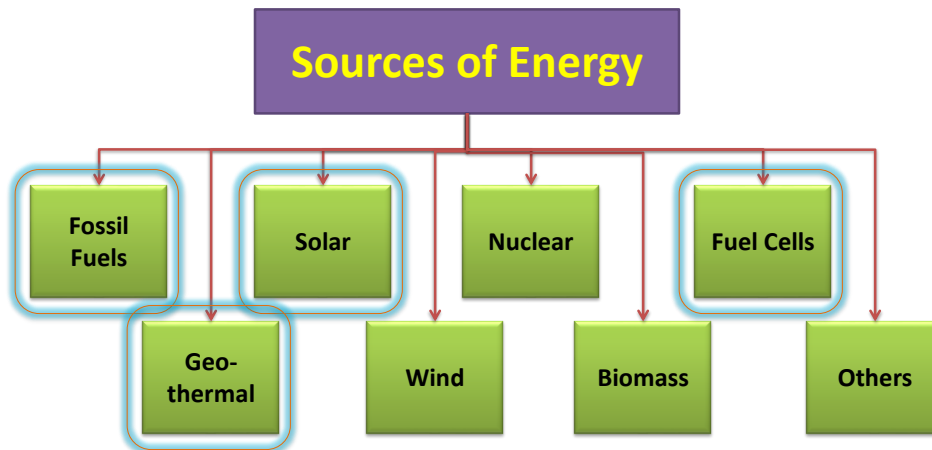
1

Energy

- ❑ Energy demand increases by ~ 3% annually (wikipedia).
- ❑ Generation of energy from fuels (e.g., by combustion) require high temperature driving force.
- ❑ Fluctuations in fuel prices (like petroleum oil) are unpredictable and extraordinary (OPEC and OPAEC)
- ❑ Energy is being consumed largely worldwide (heating, transportation, and industries)
- ❑ Cheap and new resources of energy are continuously needed., or new energy-efficient designs are being developed.
 - Non-traditional sources of energy are developed (nuclear, fuel cells, renewable energy, H₂, solar energy, biomass etc)
 - Industries are becoming more energy-efficient
 - Fuel-efficient cars are showing up

Dr. Hatem Alsyouri

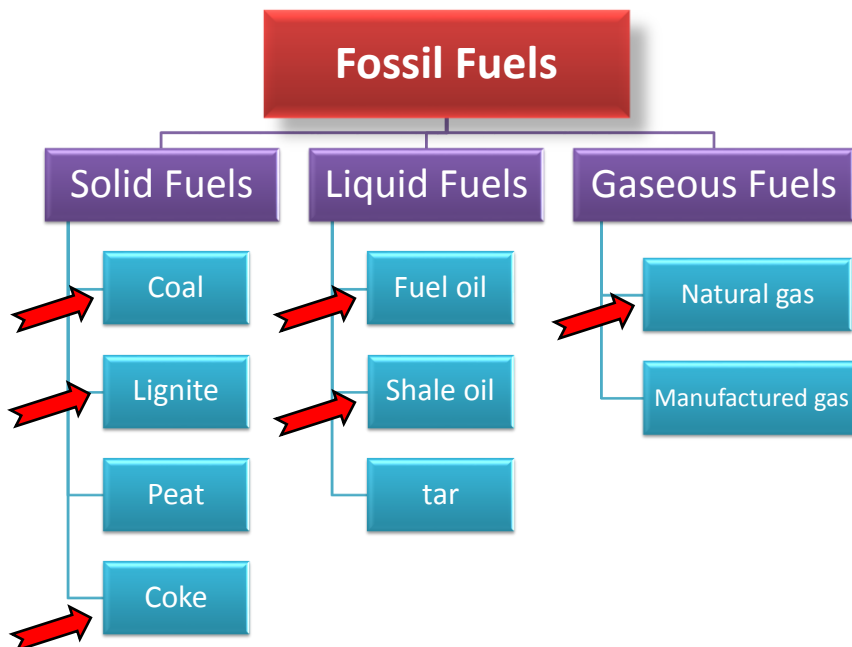
2



- ❑ Energy demand increases by $\sim 3\%$ annually (wikipedia).
- ❑ Generation of energy from fuels (e.g., by combustion) require high temperature driving force.

Dr. Hatem Alsayouri

3



Dr. Hatem Alsayouri

4

Fossil Fuels

- ❑ Fossil Fuels (FF) are formed by natural resources such as anaerobic decomposition of buried organisms over a long period of time (millions of years).
- ❑ FF contains high percentage of carbon and include solids (coal), liquids (petroleum oil), and gas (natural gas).
- ❑ FF shares 86% of primary energy consumption in the world compared to 14% contribution from the non-FF sources (hydroelectric, nuclear, solar, etc).
- ❑ FF are non-renewable because it needs millions of year to form.
- ❑ Extensive use of FF raises environmental concerns (global warming and air pollution) from:
 - CO₂ (21.3 gtonne/year half of which remain in the environment)
 - SOX and NOX emissions

Dr. Hatem Alsyouri

5

Solid Fossil Fuel: *Coal*

- The most important solid FF.
- A combustible black sedimentary rock composed of carbon along other variable elements like S, H, O, N.
- Coal is extracted from earth by mining.
- Coal is the largest source of energy for generation of energy world-wide, but is the largest source of CO₂ (more than petroleum and natural gas).
- Some classifications of coal:
 - **Anthracite** (clean burning characteristics)
 - **Bituminous** (combustion and carbonization)
 - **Sub-bituminous**
 - **Lignites**
 - **Gasified coal** such as methane (good fuel, non-polluting)
 - **pulverized coal** (also known as *powdered coal* or *coal dust* since it is as fine as face powder in women's makeup, that is blown into the firebox)



Dr. Hatem Alsyouri

6

Solid Fossil Fuel: *Lignite*

- A fuel intermediate in composition between peat (organic vegetable matter) and coal.
- Brown to black in color with C content of 25–30%.
- Energy content is 10–20 MJ/kg
- Not used in transportation but is burned in power stations constructed close to mines.
- Used almost exclusively as fuel for steam-electric power generators.



Dr. Hatem Alsyouri

Source: wikipedia

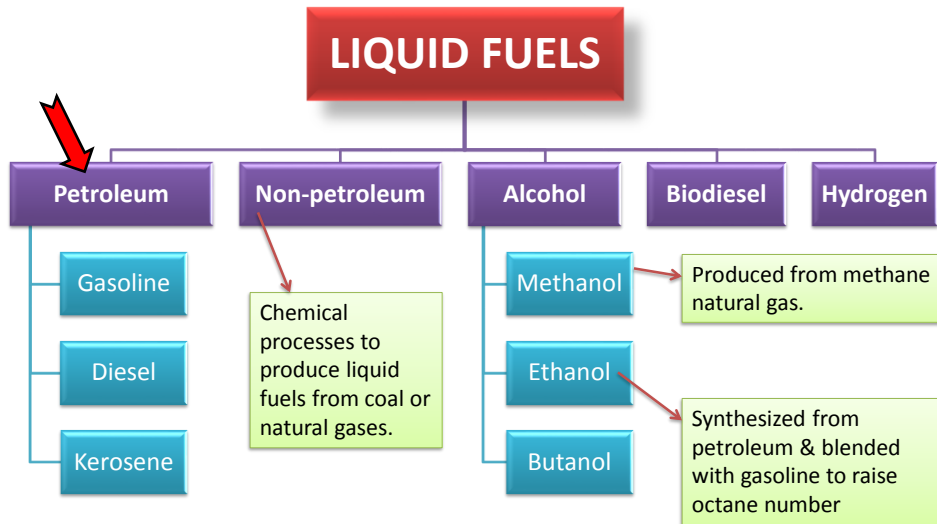
7

Liquid Fuels & Petroleum

- ❑ **Liquid fuels** are those combustible or energy-generating molecules that can be harnessed to create mechanical energy, usually producing kinetic energy.
- ❑ Most liquid fuels are or derived from fossil fuels. However, there are several types, such as hydrogen fuel (for [automotive](#) uses), which are also categorized as a liquid fuel. It is the fume of Liquid fuels that are flammable instead of the fluid.
- ❑ Most liquid fuels are produced from petroleum. The most notable of these is gasoline.
- ❑ Petroleum is formed from the fossilized remains of dead plants and animals by exposure to heat and pressure in the Earth's crust. It's extracted from earth by different methods.
- ❑ Production of gasoline is achieved by distillation of crude oil. The desirable liquid is separated from the crude oil in refineries

Dr. Hatem Alsyouri

8



Dr. Hatem Alsyouri

9

Natural Gas

- ❑ **Natural gas** is a gas consisting primarily of methane, typically with 0-20% higher hydrocarbons (primarily ethane).
- ❑ Most natural gas is created by two mechanisms: biogenic and thermogenic. Biogenic gas is created by methanogenic organisms in marshes, bogs, landfills, and shallow sediments. Deeper in the earth, at greater temperature and pressure, thermogenic gas is created from buried organic material.
- ❑ Before natural gas can be used as a fuel, it must undergo processing to remove almost all materials other than methane. By-products include **ethane, propane, butanes, pentanes**, and **higher molecular weight hydrocarbons, elemental sulfur, carbon dioxide, water vapor**, and sometimes **helium** and **nitrogen**.
- ❑ Natural gas can be converted to liquid form by **Gas-to-liquid (GTL)** technology that converts stranded natural gas into synthetic gasoline, diesel or jet fuel through the **Fischer-Tropsch** process.

Dr. Hatem Alsyouri

10