CHAP-(5&9)- ENERGY RESOURCES/ NATURAL RESOURCES: -

Energy resources are either *renewable* or *non-renewable*. *Renewable energy* is energy that is obtained from renewable resources such as sunlight, wind, rain, tides etc. These resources are naturally replenished on a human scale. In nut shell, renewable energy can be used again & again as the sources from where they are obtained are inexhaustible (virtually limitless). *India has the fifth largest power generation portfolio worldwide with a power generation of* 304.76 GW

Non-Renewable Resources:

Are those resources that take millions of years to form & will be finished after a certain period, if not managed properly. Examples are *fossil fuels- coal, petroleum, natural gas, minerals* (*Metallic, Non-Metallic-Energy minerals (e.g, coal)* etc. These resources are also called as exhaustive energy resources (supply available to society is limited).
These resources of energy produce more energy per unit than do renewable energy resources.

Types of Renewable Sources of Energy: (*six primary types*):

a) Solar Energy: (Harnessing the sun's energy) as is the case with photovoltaic cells, in which the solar energy is trapped via solar panels to generate electricity or to produce heat to warm water (solar thermal), India has third largest capacity of concentrated solar power (CSP). *The states with very high potential are Rajasthan, Northern Gujrat, Ladakh, Andra Pradesh, Maharashtra, MP.* Solar energy can be converted directly into electrical energy (direct current or DC) by photovoltaic (PV) cells, commonly called solar cells. PV cells are made of silicon & other semiconductor materials. When sunlight (photons) strikes the silicon atoms, it causes electrons to flow, creating an electric current, a principle called 'photoelectric effect'.
b) Wind Energy: The term "wind energy" describes the process by which the wind is used to generate electricity.
Types: a) *Onshore wind farm:* These are located on land where the wind is strongest, are less expensive to handle & maintain. b) *Offshore wind farm:* Are located in water bodies, are expensive & handling is difficult.
Operation:
A wind works opposite to the fan. Instead of using electricity to make wind, like a fan, wind turbines use wind kinetics to make electricity. The wind turns the blades, which spins a shaft, which connects to a generator & makes electricity. Wind turbines, like wind mills, are usually mounted on a tower to capture the most energy. At 100 feet (30 meters) above ground. India has fourth largest wind installed capacity in the world, 95% concentrated in seven states *(Andra Pradesh, Gujrat, Karnataka, Madya Pradesh, Maharashtra, Rajasthan, Tamil Nadu).*
c) Hydro power: Hydro energy is derived from the movement of water. One form of hydro power is generated through the movement of water through turbines, such as water running through turbines in a Dam.

d) Geothermal Energy: Geothermal energy comes from the Greek word "Geo" meaning Earth, the energy derived from the heat that is given off by the Earth e.g, steam energy or hot water that is generated by the Earth can be used to generate energy. The necessary condition to capture geothermal energy is above normal geothermal gradient (increase in temperature with depth in earth's crust). Normal; 2.5 – 3 ^{O}C per 100 m. The Puga Valley in the Ladakh region has the most promising geothermal field.

e) Biomass: It refers to living organisms, mostly plants or plant-derived materials. Biomass energy is produced from organic materials such as plants & animals. Biomass is matter usually thought of as garbage e.g, like leaves, tree branches, leftover crops, wood chips & bark. It can even include animal manure & old tires. The burning of biomass does not increase atmospheric carbon dioxide (carbon neutral) because, to begin with, biomass was formed by atmospheric carbon dioxide & the same amount of CO2 is released on burning e.g, syngas or producer gas.

f) Tidal energy: The tidal power is harnessed by building a dam across the entrance to a bay or estuary. As the tides rises, water is initially prevented from entering the bay. Then, when the tides are high, & water is sufficient to run the turbines, the dam is opened, & water flows through it, turning the blades of the turbines. Again, when the reserviour (the bay) is filled, the dam is closed, stopping the flow & holding the water in the reserviour. When the tides fall (ebb tide), the water level in the reserviour is higher than that in the ocean. The dam is opened to run the turbines (which are reversible), & electricity is produced as the water is let out of the reserviour.

Biofuels: Any hydrocarbon fuel i.e., solid (wood, manure), liquid (bioethanol, biodiesel) or gas(biogas), that is produced from an organic matter which may be living or once living material, in a short period of time is considered a biofuel. Biofuels emit less CO2 than conventional fuels, they can be blended with existing fuels as an effective way of reducing CO2 emissions in the transport sector.

First generation Biofuels	***2G- Biofuels***	***3G- Biofuels***	***4G- Biofuels***
Produced directly from food crops, it has high carbon content, made from edible items e.g, sugar, corn, starch etc.	***Produced from non-food crops, e.g, rice husk, wood chips etc. Greenhouse gas content is less than Ist Generation Biofuels.***	***Produced from specially engineered energy crops such as algae. It is carbon neutral.***	***Made from genetically engineered crops, are carbon negative, aimed at not only producing sustainable energy but also a way of capturing & storing CO2, also reduces CO2 emissions by replacing fossil fuels.***

IMPORTANT BIOFUELS:

Ethanol	***Also known as grain alcohol, has long been used as oxygenate to reduce CO emissions, in which case the gasoline/ ethanol mixture is usually referred to as gasohol (blend of ethanol & gasoline). The two mixtures commonly used blend are E10(10% ethanol, 90% gasoline, by volume) & E85(85% ethanol, 15% gasoline)***
Biodiesel	***Created from vegetable oils or animal fats. It is biodegradable, domestic, renewable energy fuel, its net CO2 emissions are only about one- fourth that of standard diesel. Biodiesel can be blended with conventional diesel in a mixture strength e.g, B2(2 % biodiesel, 98% standard diesel, B5 & B20. Biodiesel is produced using a process called transesterification in which unwanted glycerol in vegetable oil or animal fat is removed by chemical reactions involving an alcohol, such as methanol (producing methyl ester) or ethanol in presence of sodium or potassium hydroxide as a catalyst.***
CNG (Compressed Natural Gas)	***Is made by compressing natural gas which is mainly composed of methane. CNG combustion produces fewer undesirable gases than petrol, diesel & LPG. CNG is a very clean fuel resulting in very low emissions of reactive hydrocarbons, CO, particulate & toxics.***
LPG (Liquefied Petroleum Gas)	***It is a mixture of gases consisting of primarily propane or butane. It is obtained either from crude oil or from natural gas. LPG is volatile & highly inflammable. Since the hydrocarbons do not have any smell a small quantity of powerful odorant, ethanethiol, is added so that leaks can be detected easily.***
Biobutanol	***Biobutanol is a four-carbon alcohol produced by the fermentation of biomass. The production of biobutanol can be carried out in ethanol production facilities. Its properties are similar to that of gasoline. It has a lower energy than that of gasoline (about 10-20%), but exhibits the potential to reduce carbon emissions by 85% when compared to gasoline.***
Biogas	***Biogas is primarily methane (50 – 60%) & carbon dioxide (35 – 50%). It is produced through a process of anaerobic decomposition (anaerobic digestion) from biomass. Anaerobic digestion uses the process of fermentation to break down organic matter. After purification, it is compressed & called Compressed Bio-Gas (CBG) (pure methane content of over 95%) is similar to CNG in its composition & energy potential. Biogas production is carbon-neutral fuel.***
Syngas or producer gas	***Biomass such as bagasse, rice husk, coconut shells can be transformed to producer gas or syngas by a method called gasification (conversion of dry organic or fossil based carbonaceous materials into CO, CH4, Hydrogen & CO2 at elevated tempt. Of about500^0 – 1800 C) of solid fuel.***

POINTS TO PONDER: **1- A *resource* means a reserve source of supply. Any material which can be transformed in a way that it becomes more valuable & useful, can be termed as resource. 2. Subgroup of a resource that have been explored for the benefit of mankind is a 'reserve.' representing a stock or portion of resources.**

3. According to World Energy Council (WEC, 1998)- *"Resources are occurrence of materials in the recognizable form".*

FUEL	PRODUCTION	ADVANTAGES	LIMITATIONS
Nuclear energy	*Nuclear fission & Nuclear fusion.*	*No air pollution, fuel efficient.*	*High cost of construction, security & nuclear accidents, the problem of safe disposal of nuclear waste in the case of nuclear fission reactors.*
Hydropower	*Dams built on rivers for electricity generation.*	*The world's hydroelectricity potential is high, it is relatively cheap & clean source of energy.*	*Ecosystem behind dams disturbed, human settlements uprooted, biodiversity loss, fertile farmland is lost, the amount of nutrient-rich silt to the downstream of the dam is lost.*
Solar energy	*From natural sunlight.*	*Environment friendly, unlimited.*	*Limited capacity for storage of sunlight, diurnal & seasonal variations & grid management.*
Wind energy	*Windmills were in use for long for irrigating crops*	*No pollution, available for free.*	*Intermittently available, fans of windmills are visual hazards for flying birds & airplanes.*
Tidal energy	*Harnessing tidal power by suitable structures.*	*Free & clean.*	*Structures(plants) used for harnessing energy are expensive, structures(plants)disrupt the natural flow of the estuary & concentrate pollutants in the area.*
Geothermal energy	*Wells are drilled to trap steam, which powers electrical generators.*	*Environmentally friendly.*	*Steam contains H2S (Hydrogen Sulphide) having the odor of rotten eggs, minerals in the steam are corrosive to pipelines & equipment, causing maintenance problems. Minerals in the water are toxic to fish.*
Biomass	*Cutting trees for fuel wood & burning them straight away.*	*Cheap & hence popular.*	*Comparatively low levels of energy, bulky, so difficult to transport, causes air pollution, destruction of forests & desertification, releases a lot of fly ash.*
Biomass conversion	*Obtaining energy from chemical energy stored in biomass.*	*Renewable energy.*	*This may lead to food shortage because nutrients are not returned to soil from biomass. Growing <u>maize</u> for ethanol requires more energy expenditure in the for of alcohol; retrieved, land for growing food is used for growing biomass for conversion into fuel.*

OTHER IMPORTANT EXAMPLES OF RENEWABLE SOURCE OF ENERGY:

(Forests, aquatic ecosystems, crops, water, soil, domestic animals, wild animals)

Forests:

Boreal Coniferous Forest/ Northern Coniferous Forest/ 'Taiga'. (lowest productivity among the forest ecosystems- typical soil is podzol- devoid of organic matter due to leaching of nutrients to the bottom layers)	**Characteristics:** ***1)-It is found in the southern half of Canada, parts of northern Europe & much of Russia 2)- The climate is short, cool summers, long & harsh winters with abundant snowfall 3)- Precipitation ranges between 25 to100 cm per year, landscape is typically dotted with lakes, ponds & bogs 4)-Conifers such as spruces, firs are the most common trees in these areas. The needle- shaped leaves are adapted to prevent water loss. 5)-Typical mammals are deer, caribou, wolves & birds such as woodpecker, owls are common***
Temperate Deciduous Forest. (British Type Climate).	**Characteristics:** ***1)-Moderate climate with annual rainfall of 75 – 150 cm & tempt. Of 10 – 20 ^{0}C 2)- Soils are deep podzols, trees are tall 40-50 cm in height with thin & broads leaved deciduous trees 3)- Flora- maple, oak, chestnut, cottonwood, willow. In Himalayas, temperate forests exist at height between 2500 m to 3700 m with prominent vegetation of pines, fir, juniper, mosses, lichens & less epiphytes also are found.*** ***Fauna: Deer, bears, squirrels, gray foxes, wild turkey. Birds like horned owls & hawks.***
Temperate Evergreen Woodland/ Chaparral	**Characteristics:** ***1)-Also called as Mediterranean woodland or 'Chaparral biome' found along the coast of Mediterranean coast, California, central Chile, south-west part of South Africa & Australia 2)- Hot & dry summers & mild wet winters 3)-stunted shrubs to with-stand hot summer drought & due to this, the chaparral vegetation is also known as sclerophyllous. Height of trees 2-3 m. 4)- Flora: mostly shrubs which are evergreen, leaves are thick & needle with thick cuticle. 5)- They are called*** **'Macquis'** ***in Europe & north Africa,*** **'Mattoral'** ***in Chile &*** **'Malle'** ***in subtropical Australia.***
Temperate Rain Forest	***Characteristics: 1- Colder ecosystem than other rainforests, rainfall is high 2- Species diversity is lower than rainforests 3- The dominant tree species are coast redwood of pacific coast of North America & alpine ash of Australia & Tasmania (100 mts height)***

Tropical Rainforest ***(A fully developed tropical rain forest has atleast three distinct layers; the topmost storey consists of very tall trees, exposed to direct sunlight; the middle storey reaches a height of 30 to 40m & forms a continuous canopy of leaves, only 2% to 3% of the light bathing the forest canopy reaches the forest understory; Smaller plants specialized for life in the shade, as well as the seedlings of taller trees, compose the understorey).***	***Characteristics: 1- Tropical rainforests are located close to the equator, & the largest area of tropical rainforest in the world is the Amazon rainforest in South America 2- Most areas receive in excess of 200 cm (80 inches) of rain per year. Little or sunlight reaches the forest floor, supporting ferns. 3- Because of darkness & extensive root systems present on the forest floor, animals of the tropical rainforest are primarily arboreal such as sloths, jaguars.***
Sub-tropical Rain Forest	***Characteristics: 1- Broad leave evergreen subtropical are found in areas with high rainfall & where the variation between winter & summer tempt. Is less e.g, Florida & some parts of India 2- Major flora: Mahogany, palms, oaks, tamarinds, epiphytes, ferns are common, trees relatively evergreen except for brief dry season shedding 3- Animal life is similar to tropical rainforests.***

RAINFORESTS OF INDIA:

Moist Tropical Forest	***Montane sub-tropical forest***	***Montane wet tempt. Forests***
Assam, Odisha & west Bengal, Andaman & Nicobar Islands.	***Hill forests of Assam & west Bengal, Kerala, Pine forests of UP, Uttarakhand, HP, Assam & Manipur.***	***Forests of Kodaikanal & Udagamandalam in TN & Kerala., N-E & parts of Bengal.***

IMPORTANT FOREST TYPES OF INDIA.

TROPICAL WET EVERGREEN FORESTS:

Distribution	***Climate***	***Major Plant Species***	***Characteristics***
Western slope of Western Ghats, hills of north-eastern region & Andaman &	***Warm & humid areas, Annual precipitation of over 200cm, mean annual tempt. Above 22^0C (27^0C – 30^0C)***	***Trees of chiefly of hardwood type, Rosewood, Mahogony, Ebony.***	***1-Tropical evergreen forests are well stratified, with layers close to the ground & are covered with shrubs & creepers with short structured trees followed by tall variety of trees. 2-Tiers***

the Nicobar Islands.	***Comparatively short dry season (about 3-4 months)***		***of trees are covered with climbers & epiphytes. A variety of orchids flourish on the trees. Diversity of plants: in a single acre, hundred different species of trees can be found 3- In these forests, trees reach great height up to 60 m or above. As there is abundance of moisture availability, there is no definite time for trees to shed their leaves or flowering. As such these forests appear green all the year around.***

Tropical Semi Evergreen Forests

Less rainy part of the above areas where rainfall decreases from 250 to 200 cm, Found along western Ghat from Cochin to Mumbai, upper Assam region, lower slopes of eastern Himalaya, Odisha & adjoining hills of Andaman & Nicobar Island	***Tempt. 24 – 27^{0}C***	***Semul, white cedar, Champa, Mango, Indian Chestnut.***	***1-Moisture is not adequate to keep them evergreen & the deciduous trees increase in number. 2- Such forests have a mixture of evergreen & moist deciduous trees. The under growing climbers provide an evergreen character to the forests. 3- Relatively less dense canopy & heavy climbers. Underground cover is made up of evergreen shrubs 4- Epiphytic mosses, ferns & orchids are present.***

Tropical Dry Evergreen Forests:

East coast of the Peninsula, north of Nellore in Tamil Nadu & Andra Pradesh	***Annual rainfall is about 100cm, mean annual tempt. 28^{0}C, rainfall comes mainly from NE monsoon.***	***Ebony, Spanish, Cherry, Poison nut, Soapnut***	***Predominantly evergreen broadleaved with some deciduous trees, often dense but usually under 20m***

Tropical Deciduous Forests/ The Monsoon Forests: Most widespread forests in India:

Northeastern states along the foothills of Himalayas, eastern slopes of the Western Ghats & Odisha, Central plateaus including Chotanagpur, Upper Mahanadi Valley, Vindhyan & Satpura hills. A belt running north-south of the eastern slopes of the Eastern Ghats west of the evergreen belt in Maharashtra, Karnataka, Kerala & Tamil Nadu. Hilly areas in the eastern part of the Deccan including Eastern Ghats in Tamil Nadu.	***Rainfall 100 – 200 cm, mean annual tempt. 24^0C***	***Sal & Teak are the two most important trees, Shisham, Hurra, Mahua, Amla, Semul, Kusum, Arjun, Mulbery, Haldu, Siris, Sandalwood***	***1-As the dry season begins, the trees shed their leaves completely & the forest appears like a vast grassland with naked trees all around.*** ***2- An irregular top storey of predominantly deciduous species 40m or higher, existence of a second storey, undergrowth of shrubs including heavy climbers like canes.***
Dry Deciduous Forests: ***Covers vast areas of the country. These forests are found in rainier area of the Peninsula & the plains of the Uttar Pradesh & Bihar. In the higher rainfall regions of the peninsular plateau & the northern Indian plains, these forests have a parkland landscape with open stretches in which teak are interspersed with patches of grass.***	***Rainfall 70-100cm***	***Tedu, Palas Amaltas, Bel, Axlewood.***	***1-On the wetter margins, it has a transition to the moist deciduous, while on the drier margins to thorn forests. The climbers are few.*** ***2-In the south most, characteristic tree is Teak. In the Northern region of Punjab, UP, HP &hilly tracts of Bihar & Odisha, the dominant tree is Sal & the forests are known as Siwalik Hill Sal Forest & dry peninsular forest.***

Sub-Tropical Broad Leaved Hill Forests:

Found between 1000- 1700m above sea level, Southern Hill Forests: found in Nilgiris, Central India, Rajasthan & Bihar *Northern Hill Forests: found in the North East India, West Bengal. Assam & other north eastern states.* *Found in the Punjab, UP & Assam.*	*Rainfall 175-125 cm Mean annual tempt. 18 to 21^{0}C. Rainfall 150 to 300cm.*	*Pine, predominant broad-leaved trees are Quercus (Oak) associated with Rhododendron, Mallotus, Casa.*	*These are mixed forests of broad-leaved trees & conifers; Vegetation is predominantly associated with Pine.*

Montane Temperate Forests:

Western Ghats & the Himalayas			*The conifer forest of India is restricted to Himalayas only, located in high altitude mountains.*

Montane Wet Temperate Evergreen Forests:

Confined to Nilgiri, Anamalai & Tirunelvi hills in South India & high hills of eastern Himalayas in West Bengal. Assam & Arunachal Pradesh	*Above the height of 1500m where mean annual tempt. Is 11 to 14^{0}C & rainfall is 150-300cm*	*Deodar, Indian Chestnut, Blur Pine Oaks, Hemlock etc. associated with Oaks are mainly Rhododendrons, Birch. Plum.*	*Evergreen forests with short branchy trees attaining high girth. Height rarely exceeds 6m. Branches are covered by mosses, ferns & other epiphytes. Woody climbers are common. In South India, these are known as 'Sholas'. The trees found in shoal forests are not found anywhere else in India.*

Himalayan Moist Temperate Forests:

Along the entire length of Himalayas at height of 1600 to 3500m.		***Oaks, Deodar, Fir, Spruce. 1-Sub Alpine Forests: stunted deciduous or evergreen forest with or without conifers. Spruce, Fir, Birch 2- Moist Alpine scrub: Birch, Rhododendron 3- Dry Alpine Scrub: Xerophytic scrub with a preponderance of Junipers.***	***1-Evergreen coniferous forests 30 to 50m high with mosses & ferns growing on trees. 2-Among the broad-leaved species Oaks are most common 3- Above the timber line, high forests are replaced by Alpine scrub.***

SWAMP/ MANGROVE FORESTS:

Mangroves are salt tolerant(halophytes) evergreen shrubs or small trees (vary in height from 8 to 20m) that represent a characteristic littoral (near the sea shore) forest ecosystem e.g. mudflats, tidal creeks, marshes & lagoons of tropical & subtropical regions. Mangroves exhibit varied morphological & physiological adaptations to survive the limiting factors like lack of oxygen, high salinity.

The adaptations include:

Succulent leaves (thick leaves adapted to store water & reduce evapotranspiration), sunken stomata (to protect from drying wind), leaves with salt secreting glands (to flush out the excess salt), aerial breathing roots called pneumatophores, stilt & prop roots (they are fibrous -adventitious-support roots emerging from the main trunk above ground level acting as support roots like cables), the pneumatophres (blind roots), prop roots & stilt roots help mangroves overcome the respiration problem e.g. Rhizophora & Avicennia.

Mangroves of Sundarbans (India & Bangladesh): ***from 'Sundari' mangrove tree. It is the largest single block of tidal halophytic mangroves in the world, is the only mangrove forest inhabited by tigers. Fauna- Royal Bengal Tiger, salt water crocodile, Ganges River Dolphin, mangrove horse shoe crab.***

Other Major Mangrove Forests on the East Coast: ***The mangroves of Bhitarkanika (Orissa), the second largest in India, harbour a high concentration of typical mangrove species & high genetic diversity.***

Mangrove Forests on the West Coast: ***On the west coast of India, mangroves, mostly scrubby(stunted) & degraded, occur along the intertidal region of estuary & creeks in Maharashtra, Goa & Karnataka. The mangrove vegetation in the coastal zone of Kerala is very sparse & thin.***

In Gujrat mangroves are mainly found in the Gulf of Kutch & the Kori creek region, forming narrow, discontinuous patches on soft clayed mud.

Importance: ***1-Act as riparian (situated on banks) buffer & trap pollutants, enhancing the natural recycling of nutrients. 2- Mangroves (ecotone between land & sea) are highly productive ecosystems with rich biodiversity. 3- Act as buffer by enhancing sediment deposition 4- Mangroves are an essential carbon sink. 5- They provide a safe & favourable environment for breeding, spawning & rearing several fish spp.***

Non-Renewable Resources/FOSSIL FUELS:

Fossil fuels are in the top of the list of energy resources. Fossil fuels are formed from plant & animal remains buried in the earth for millions of years. The fossil fuels provide 85%-90% of the energy demand of the present industrialized world. These fossil fuels include: -

A) Coal B) Oil & Natural Gas.

In India coal constitutes the mainstay of power generation in India. It constitutes about 70% of total commercial energy consumed in the country. The power sector & industries account for 94% of the total consumption. Due to its high utility, it is often called 'black gold'. Most of the coal has been formed during the carboniferous period in geological history owing to the submergence of natural vegetation & as a result of combined effects of microbial action, pressure & heat over a considerable time period. This process is commonly called 'coalification'. The process takes millions of years. The greater the depth of the deposit the more mature is the coal. It is composed mostly of carbon (50-98%), hydrogen (3-13%) & oxygen, & smaller amounts of nitrogen, sulphur. When burnt coal releases energy as heat.

Coal bearing strata of India: - Geologically classified into two main categories: -

1-Gondwana Coal: This coal is about 250 million years old. It accounts for 98% of the total reserves & 99% of the production of coal in India. It is the store house of superior quality of coal. Anthracite is generally not found in the Gondwana fields.

2- Tertiary Coal: It is about 15-60 million years old & is mainly found in the extra peninsula.

CLASSIFICATION OF COAL: As per the International Coal Classification of the Commission for Europe (UNECE) coal can be divided into two broad categories:

a) Hard Coal: Coal of gross calorific value not less than 5700 kcal/kg. e.g. Anthracite, Bituminous, Coking coal.

b) Brown Coal: Gross calorific value less than 5700 kcal/kg. e.g sub-bituminous coal.

Based on carbon content, coal may be of following types: -

Anthracite Coal	Bituminous Coal	Lignite Coal	Peat Coal
It is dense, hard rock with metallic lusture, it contains very low Sulphur (S) & high Carbon (about 86% - 98%), burns slowly with pale blue flame & lowest smoke, volatile matter is low being just 2% -14%, mainly occurs in UK & USA, used in industrial furnaces & in metallurgical processes.	*It is a medium-rank coal next to anthracite used for gasification, industrial cooking & heat raising. It contains 69%-86% carbon by weight, Bituminous coal when used in the production of a coke is known as coking coal.*	*It is very soft coal contain up to 17% (moisture content of about 30 – 50%) water by weight, inferior quality, low grade coal. In Latin, Lignum means wood, carbon content of about 25 – 35%, due to high moisture-rapid oxidation & low heating value.*	*Peat is a solid fuel with highest moisture content (about 90%), partially decomposed coal, less heating value & carbon content <25%*

The rank of coal from most to least Carbon content: -

Anthracite > Bituminous > sub bituminous > lignite

The rank of coal from most to least Sulphur content: -

Bituminous > Anthracite > Sub bituminous > lignite

The rank of coal from most to least Moisture content: -

Lignite > sub-Bituminous > bituminous > Anthracite

=Sub-bituminous coal is black in colour & dull, <50% carbon content, higher heating value than lignite=

World Coal Production in MT (METRIC TONNES)	
China	***3942***
India	***767***
Indonesia	***550***
Coal Reserves in India	***: Reserves in Billion Tonnes***
Jharkhand	***86.2***
Odisha	***84.8***
Chhattisgarh	***73.4***

OIL & NATURAL GAS:

Oil & natural gas provide 67% of the world's energy, globally. The source material, or source rock, for oil & gas is fine grained (less than 1/16 mm, or 0.0025 in, in diameter), organic-rich sediment buried to a depth of atleast 500m (1640ft), where it is subjected to increased heat & pressure. The elevated tempt. & pressure initiate the chemical transformation of the sediment's organic material into oil & gas. The pressure compresses the sediment & with elevated tempt. In the source rock, initiates the upward migration of the oil & gas, which are relatively light, to a lower-pressure environment (known as reserviour rock). The reserviour rock is coarser grained & relatively porous (it has more & larger spaces between the grains e.g. sandstone & porous limestone have 30% of empty space).

Both petrol & diesel are obtained during fractional distillation (a process in which crude oil is first heated to vapourize it. The vapour then rises through a vertical column, where it's tempt. decreases with height. Heavier components condense out at higher tempt. So, they are removed near the bottom of the column. The lighter components rise higher before condensing, with gasoline near the top) of petroleum. Petrol is produced at temperature between 35^{O} to 200^{O} while diesel is produced at a boiling point of 250-350 degrees. After distillation, in order to use these by products as commercially acceptable petrol & diesel, some blending with other elements has to be done. Petrol is produced first in this process as it is produced at a lower tempt. than diesel.

The contents of natural gas are mainly methane (83%), ethane (7.2%), propane (2.3%), butane (1%), N_2(5.8%), CO2 (0.2%).

About half of the world's total estimated reserves are situated in the Persian Gulf region, which includes Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia, Syria, The United Arab Emirates, Yemen. More than 40% of the world's proved recoverable reserves of natural gas are located in two countries, Russia & Iran.

MINERAL RESOURCES:

A mineral is a naturally occurring inorganic substance, having an orderly atomic structure & a definite chemical composition & physical property. A mineral is composed of two or more elements, but a single element minerals like sulphur, copper, silver, gold, graphite are also found.

About 98% of the total crust of the earth is composed of eight elements like oxygen, silicon, aluminium, iron, calcium, sodium, potassium & magnesium & rest is constituted by titanium, hydrogen, phosphorous, manganese, sulphur, carbon, nickel & others.

The basic source of all minerals is the hot magma in the interior of earth. Minerals such as coal, petroleum & natural gas are organic substances found in solid, liquid & gaseous forms.

Physical characteristics: ***1- Crystal form-is determined by internal arrangement of molecules like, cubes, hexagonal prisms.***

2- Cleavage- tendency to break in given directions producing relatively plane surfaces at any angle.

3-Fracture- crystal will break in an irregular manner, not along planes of cleavage.

4-Lustre= appearance of a material like metallic, glossy etc.

5-Colour- determined by their molecular arrangement e.g. malachite, while some minerals are coloured by impurities e.g. quartz may be white, green, red, yellow etc.

6-Hardness- relative resistance being scratched, ten minerals are selected to measure the degree of hardness from* 1-10 *& are:

1.Talc 2. Gypsum 3. Calcite 4. Fluorite 5. Apatite 6. Feldspar 7. quartz 8. Topaz 9. Corundum 10. Diamond.

Major Minerals:

Feldspar- Silicon & oxygen are common in all types of feldspar & sodium, potassium, calcium, aluminium are found in specific feldspar variety, half of earth's crust is composed of feldspar, has light salmon pink colour, used in ceramics & glass making.
Quartz- Component of sand & granite, consists of silica, hard mineral used in radio & radar.
Pyroxene- consists of calcium, aluminium, magnesium, iron & silica, forms 10% of earth's crust, commonly found in meteorites, green or black in colour.
Amphibole- major elements are: aluminium, calcium, silica, iron, magnesium, forms 7% of earth's crust, used in asbestos industry.
Mica- comprises of potassium, aluminium, magnesium. Iron, silica etc. forms 4% of the earth's crust, commonly found in igneous & metamorphic rocks, used in electrical appliances.
Olivine-Major elements are: magnesium, iron & silica, used in jewellary, greenish crystal, found often in basaltic rocks.

Metallic minerals: ***These minerals contain metal content & can be sub-divided into three types: i) Precious metals: gold, silver, platinum ii) Ferrous metals: iron & other metals often mixed with iron to form various kinds of steel iii) Non-ferrous metals: include metals like copper, lead, zinc, tin, aluminium.***

Non-metallic minerals: ***These minerals do not contain metal content etc. Sulphur, phosphates & nitrates, cement (a mixture of non-metallic minerals).***

MEDICINAL PLANTS:

The principal group found in medicinal plants or herbs are:
Alkaloids(ringed structure containing atleast one nitrogen, act as stimulants & psychotropic substances e.g, nicotine, quinine, morphine, caffeine, codeine, vincristine, Atropa from *Atropa belladonna* used to cure skin infections, other examples are-hyoscine, hyoscyamine, Taxol- in treatment of breast cancer), Glycosides(organic compounds that contain a sugar molecule, glycone attached to a non-sugar moiety, aglycone by a glycosidic bond, having anti-viral property e.g. anthocyanin, rutin as ant-diabetic, antibiotic such as erythromycin), saponins(are steroid, the toxicity is thought to be a result of their ability to form complexes with sterols & the uptake of this toxin disrupts cell membranes e.g. SaikosaponinA, Timosaponin AIII in cancer treatment), essential oils(plant extracts like eucalyptus in clearing sinuses, Lavender in improving sleep, Peppermint to boost alertness & reduce headaches), bitter principles(chemicals with bitter taste, administered as convalescents), tannins(non-nitrogenous chemicals that promote rapid healing & inflammation of gums), mucilages(polymer of sugars e.g. polysaccharides).
28% of the plants found on the earth are being used for medicinal purposes. 20,000 spp. Globally have been listed as of potential medicinal value.
1-Chinese medicine for malaria is *Artemisinin*, a terpene derived from the annual wormwood *Artemisia annua*, an alternative to quinine in the treatment of malaria.
2-Rosy periwinkle *Catharanthus roseus* of Madagascar produces two alkaloids, vinblastine & vincristine that cure most victims of the two of the deadliest of cancers, Hodgkin disease & acute lymphocytic leukemia.
3-Podophyllotoxin, a drug used in treatment of certain cancers is derived from the rhizomes of *Podophyllum ascendium, Podophyllum hexandrum, commonly called* 'Bon-wagun'.
***4*-Pilocarpine, *derived from Pilocarpus spp.* Is used as antiglaucoma drug.**
5-*Rauvolfia serpentine contains several compounds of medicinal value like rescinnamine, reserpine, used in the treatment of high blood pressure.*
6-Adiantum capillus veneris- local name is* 'Geutheer' *in Kashmiri &* Hansraj *in Hindi, perennial plant used as hair tonic & a cough expectorant.
7-Artemisia absinthium- common name 'worm wood' & in local language commonly called* 'Tethwen'*, main source of drug* 'Afsantheen' *used in chronic fevers, in inflammation of liver, as an insect repellent & a remedy against roundworms.
8-Begenia ligulata-Local name* 'Zakhmihayat'*, roots used to cure fevers, diarrhea, cough, kidney stones & in cardiac ailments.
9-Crocus sativus-commonly called* 'saffron'*, locally called* 'kung' *or* 'saffron'*, a valuable spice used as sedative & in hepatomegaly.

10-Datura stamonium- commonly called' **thorn apple'** *or '***jimson weed'***, locally as'* **datur'***, leaves & seeds are antiseptic & narcotic, leaves are applied to boils or sores, flower juice used in ear ache, also used to prevent baldness & in treatment of asthma, chest pain or in epilepsy.*

11-Dioscorea deltoidea-Perennial climbing herb, stem used as bactericide, antioxidant & in hyperglycemic cases. It produces a medically active compound as 'Diosgene' to prevent Chronic liver pain, piles & ophthalmic infections, root juice is used to treat roundworms in humans.

*12-Taraxacum officinale- known as '***Hund'***, leaves are rich in beta carotenoids, vit-C, calcium & iron, in improving gut health, bile problems.*

*13-Arnebia benthamii-perennial plant, an important ingredient of drug under the name '***Gaozaban'** *having antibacterial, antifungal, anti-inflammatory & wound healing properties, used in treatment of tongue & throat diseases.*

14-Rheum emodi- commonly called' **Pambhaakh'***, used in treatment of gastro-enteric diseases, roots used to treat cough, jaundice, blood infection, constipation & to combat diarrhea.*

*15-Viola odorata- locally called '***Banafsha'***, herbaceous flowering plant, used for a variety of respiratory ailments, in asthma & bronchitis, syrup used as laxative, leaves have ant-inflammatory properties, also used in treatment of mouth ulcers.*

16-Aconitum heterophyllum-annual herb found in grassy slopes of alpine Himalayas, tubers used as expectorant, anti-helminth, anti-inflammatory, anti-diarrhea properties, paste from leaves are also used as a remedy against snake bites.

17-Saussurea lappa- locally called' **Kuth'***, medically used as anti-cancer, anti-ulcer, anti-arthritis, used as a remedy in toothache, as an appetizer, in perfumes, in de-toxification of body.*

WATER HARVESTING/WATERSHED MANAGEMENT:

Capturing the rain water that falls, is a water conservation arrangement for proper usage of water in order to prevent water stress & water scarcity or water crisis.

Rainwater harvesting & watershed management are basic strategies & methods of water harvesting.

Strategy: SPONGE CITY CONCEPT TO CONSERVE WATER: -

The sponge city indicates a particular type of city in which water is Conserved + Stored + Recharged + Sustainably used. A sponge city does not act like an impermeable system, but acts like a sponge & absorbs the rainwater. The absorbed water is naturally filtered by the soil & allowed to reach into the urban aquifer. This allows for the extraction of water from the ground through urban or per-urban wells. This water can be easily treated & used for the city water supply.

Benefits: -1- Replenished & cleaner groundwater due to increased volume of naturally filtered stormwater.

2-Greener, healthier & more enjoyable urban spaces.

3-Enriched bio-diversity, wetlands, urban gardens & green rooftops.

Also, traditional conservation methods must be revived like;

1-Constructing farm ponds, check dams, dug wells or bore wells.

2-Artificial glaciers e.g. Ice Stupa in Ladakh pattern.

YOU HAVE REACHED THE END OF THE CHAPTER.