Natural Sources

Life on this planet earth dep
upon large number of things
services provided by the nat
which are known as Natur
resources.

Thus water, air, soil, minerals
forests, crops and wild life a
examples of natural resour

- **The natural resources are of two kin**
- **Renewable resources which are ine and can be regenerated within a giv of time e.g. forests, wildlife, wind e biomass energy, tidal energy, hydro etc.**
- **Solar energy is also a renewable for energy as it is an inexhaustible sour energy.**

- **Even our renewable resources can bec**
  non-renewable if we exploit them to s
  that their rate of consumption exceeds
  of regeneration. and recycling.

- **There are four major types of nonrene**
  resources: oil, natural gas, coal, and nu
  energy. You may add even mineral res
- **Answer ?**

Sustainable use of Resou

- It is very important to protect and c
  our natural resources and use them
  judicious manner so that we do not
  them.
- This is very important for the sustai
  development.

- **Major natural resources:**
- **(i) Forest resources**
- **(ii) Water resources**
- **(iii) Mineral resources**
- **(iv) Food resources – Not to be covered a syllabus of this course.**
- **(v) Energy resources**
- **(vi) Land resources.**

FOREST RESOURCES

- About 1/3rd of the worlds land area forested which includes closed as w open forests.
- Former USSR accounts for about a 5

of the worlds forests (20 %) , Brazil f a 7th (around 15 %), and Canada and each for 6-7%. India just 2 %

- Almost everywhere the cover of the forests has declined over the years.

Forest Area by Country

#	Country	Sqare meters per capita
1	Russia	55,992
2	Brazil	23,652
3	Canada	94,461
4	United States	9,556
5.	India	600

- **The greatest loss occurred in tropical A one third of the forest resources have destroyed.**

USES OF FORESTS

Commercial uses:

Firewood, pulpwood, food items, gum, resins, non-edible oils, rubber, fibers, lac canes, fodder, medicine, drugs and many items, the total worth of which is estima more than $ 300 billion per year

Forest

Ecological uses

- **Production of oxygen:**
- **Reducing global warming:**
- **Wild life habitat:**
- **Regulation of hydrological cycle:**
- **Soil Conservation:**
- **Pollution moderators:**

Maintaining Tiger Count in Around 3000

Restoring ecosystem- Role of Hunters ?

- Introduced 8 + 12 = 20 cheetahs bro from Namibia in Kuno Park, MP, th declared extinct in 1952 in India .

- **Total Recorded Forest Area in the co**
  765,210 sq. km, which is 23.28% of t
  geographical area of the country.

- **Recorded Forests can be broadly cla**
  into three categories Reserved Fore
  (416,516 sq. Protected Forests (223,
  km) (declared by State Govts.) and
  Unclassed Forests (125,385 sq. km).

- **Area-wise Madhya Pradesh has the**
  forest cover in the country followed
  Arunachal Pradesh, Chhattisgarh, O
  Maharashtra.

The Larger Forests in In

- **Abujmarh. Spread over about 3,870 Kr Abujmarh is a forest which is situated Chhattisgarh. ...**
- **Anekal Reserved Forest. Not much is k about this forest. ...**
- **Baikunthapur Forests. ...West Bengal**
- **Bhavnagar, Amreli Forest (Gir) ...**
- **Bhitarkanika Mangroves. ...**
- **Dvaita Forest. ...**
- **Jakanari Reserved Forest.**

Different Forests in India (List

be deleted

- Name Location Area
- Gir National Park Talala taluk, Gir district, Gujarat 1412 km^2
- Jakanari reserve forest Coimbator
- Jim Corbett National Park Nainital and Pauri Garhwal district, Uttarakh 520.8 km^2
- Kanha National Park Madhya Prad km^2

May be deleted

- **Abujmarh forest** Chhattisgarh
- **Annekal Reserved Forest** Western Gha
  Tamil Nadu, Karnataka, Goa, Maharashtra
  Gujarat.
- **Baikunthapur Forest** Dooars, West B
  This is a terai forest
- **Bandipur National Park** Karnataka 87

- **Bhagwan Mahaveer Sanctuary and Moller**
  Park Sanguem taluk, Goa 650 km²

TERAI

- The Terai is a belt of marshy grassl savannas (Scattered trees) and fo located south of the outer foothill Himalaya, the Shivalik Hills, and no the Indo-Gangetic Plain of the Gan Brahmaputra and their tributaries
- The Terai belongs to the Terai-Dua savanna and grasslands eco-region

Family visits to enjoy and und
the Biodiversity – choose - ir

- Bhitarkanika Mangroves
- Bhitarkanika lakeride sunset, Odisha 65
- Bondla Wildlife Sanctuary Ponda taluk, km² -

Provides sanctuary to leopards who have injured in human-wildlife conflict.

- Cotigao Wildlife Sanctuary Canacona -

It is known for its dense forest of tall trees (

Record for Conservation a sustainability.

- Gir National Park - Talala taluk, Gir So district, Gujarat 1412 km²
- Jakanari reserve forest, Coimbatore
- Jim Corbett National Park, Nainital distric Garhwal district, Uttarakhand 52
- Some have been repeated here as a part o Tabulation under Different Forests of Indi Please note. People from far and wide vis

- **Kanha National Park - Tiger Kanha Na Park.**

- **Madhya Pradesh 650 km² The presen Kanha area is divided into two sanctuari and Banjar, of 250 and 300 km² respectiv**

- **Keibul Lamjao National Park - Bishn district, Manipur 40 km² - The nationa The only Floating park in the World.**

  World's second biggest mangrove fore

May be deleted

- Decomposed plant materials locally ca
  phumdis.
- Kukrail Reserve Forest Lucknow, U
  Pradesh
- Mhadei Wildlife Sanctuary Sattari t
  208.5 km^2 Bengal tigers can be found
- Molai forest Majuli island on the Bra
  River 5.5 km^2- Assam
- Nagarhole National Park

Rows

- Elephant herd at Nagarahole wildlif
  sanctuary.

Kodagu district and Mysore district, K
- 642 km² One of India's premier T

Reserves

- Nallamala Hills, Hill on Top of Nalla
  Hills temple.jpg Eastern Ghats, And
  Pradesh (South of River Krishna).

May be deleted

- Namdapha National Park Arunachal P
  km^2Fourth largest national park in India.
- Nanmangalam forest Chennai, Tamil
  km^2The reserve forest area is 3.2 km^2
- Netravali Wildlife Sanctuary Goa 21
- New Amarambalam Reserved Forest
  Malappuram district, Kerala
- Pichavaram Mangrove Forest
- Pichavaram, Cuddalore district, Tamil Na

OVER EXPLOITATION OF FO

- **The international timber trade alon**
  over US $ 40 billion per year.
- **Excessive use of fuelwood and char**
  expansion of urban, agricultural and
  industrial areas and overgrazing hav
  together led to over-exploitation of
  forests leading to their rapid degrad

DEFORESTATION- Cause of Concern

- The total forest area of the world in estimated to be 7,000 million hecta was reduced to 2890 million ha in 1 fell down to just 2,300 million ha by
- At the present rate it is estimated th next 60 years we would lose more t percent of our tropical forests - Tree Transplantation, Plant 10 saplings fo one tree.

- **The forested area in India seems to stabilized since 1982.**

- **As per our National Forest Policy, as still having only 19.27 % of our land (63.38m ha) covered by forests base satellite data (MoEF, 1998).**
- **Presently around 24 %.**

Major Causes of Deforest

- **(i) Shifting cultivation: It is a farmin**
  the farmer cultivates on a plot of la
  temporarily, and when he finds the
  infertile to grow due to soil exhaust
  and shifts.
- **In India, we have this practice in No**
  and to some extent in Andhra Prade
  and M.P which contribute to nearly
  the forest clearing annually.

(ii) Fuel requirements: Growing dema
fuelwood by increasing population in

(iii) **Raw materials for industrial use: V**
making boxes, furniture, railway-slee
plywood, match-boxes, pulp for pape
etc. have exerted tremendous pressu
forests.

- **(iv) Development projects: Various** Development projects like hydroele projects, big dams, road constructio etc.
- **(v) Growing food needs: To meet th** demands of rapidly growing popula agricultural lands and settlements a created permanently by clearing for

- **Overgrazing: The forest cleared lan excessive fuelwood are turned into grazing lands.**

- **Overgrazing by the cattle leads to fu degradation of these lands.**

Major Consequences of Defor

(1) This threatens the existence of many species.

(ii) Biodiversity is lost and along with tha diversity is eroded – Cheetahs became e India, several birds become extinct, tree are lost.

(iii) Hydrological cycle gets affected, ther influencing rainfall- Transpiration.

(iv) Problems of soil erosion and loss of s increase.

(v) In hilly areas it often leads to landslid

Major Activities in Fore

- **Timber Extraction:Teak and Mahoga and Sandal wood** leads to removal trees. Construction of approach roa
- **Mining:** Mining operations for extra **minerals and fossil fuels** like **coal of** involves vast forest areas.
- Large scale **deforestation** has been in **Mussorie and Dehradun valley** du **indiscriminate mining** of **various mi**

- Indiscriminate mining in forests of Goa
- Coal mining in Jharia, Raniganj etc. – Jh Fires?
- Mining of magnesite and soap- stones (magnesium rich mineral talc.) . Kosi va Almora.
- Mining of radioactive minerals in Keral Nadu and Karnataka.

Western Ghats are also facing the same to mining projects for excavation of copp chromite, bauxite and magnetite.

Video on Natural Resou

- https://www.google.com/search?q=video+
  +resources&sca_esv=8c966bae1d54a914&
  H_enIN1045IN1045&sxsrf=AE3TifN11pB9-v
  woSWF20nJNyg:1756876884098&ei=VNC3
  EP9bHz0Ag&start=10&sa=N&sstk=Ac65TH
  vWD2UvF0OLTiHE8wT7EAV8Z6QTXFcNlwH
  MJhrQhgsz6WWuNOk3TvIuP5j5RHtH3v0Lt
  8w&ved=2ahUKEwjT3dy07LuPAxWdzTgGH
  MDegQIDBAE&biw=970&bih=408&dpr=1.6
  ve&vld=cid:30a88e55,vid:juMlBNC1EwY,st

DAMS AND THEIR EFFECTS
FORESTS AND PEOPLE

- India has more than 1550 large dam

- The highest one is Tehri dam, on riv
  Bhagirathi in Uttaranchal and the la
  terms of capacity is Bhakra Nangal
  river Satluj in H.P.

- **The crusade against the ecological d**

and deforestation caused due to Tehr
led by

Sh. Sunder Lal Bahuguna, the leader o
movement. The cause of Sardar Sarov
related issues has been taken up by th
environmental activists Medha Patek
by Arundhati Ray and Baba Amte.

- For building big dams, large scale de
  of forests takes place which breaks
  natural ecological balance of the reg

- Floods, droughts and landslides bec
  more prevalent in such areas.

Assignment 1

- Rare earth metals-Importance, uses, occurren
  production and current demand for permaner
- (Last date for submission : September 20, 20
- Page limit is 5 - 6 pages , excluding figures an
  any.
- Double spaced Font size 14.
- They may include some references which may
  counted within 5-6 pages. You may refer to th
  Books, Encyclopedia, Wikipedia etc. for the in
  Write in your own words.
- Use of turnitin for checking plagiarism and de
  marks for late submission and plagiarism.

WATER RESOURCES

- India accounts for 18% of the world po
  and about 4% of the world's water res
- About 97% of the earths surface is cov
  water and most of the animals and pla
  60-65% water in their body.
- Unique features of water
- 1. Liquid over a wide range of tempera
- 2. Due to highest specific heat, it warm

cools down very slowly without causing s
temperature jerks to the aquatic life.

3. Due to high latent heat of vaporiza
produces a cooling effect as it evapora

4. It is an excellent solvent for several
including oxygen.

5. Due to high surface tension and coh
can easily rise through the trunk even
tallest of the trees like Sequoia .

Sequoia Trees (About 84 r

- **6. It has an anamolous expansion b**
  (4 Deg. C TO 0 Deg. C i.e. as it freez
  expands instead of contracting and
  becomes lighter and in extreme col
  lakes freeze only on the surface.
- **Aquatic animals can survive.**

Being lighter the ice keeps floating, w
the bottom waters remain at a higher
temperature and therefore, can susta
organisms even in extreme cold.

OTEC – Ocean Thermal Energy Conver
Power Generation in the sea and ocea

- The water we use keeps on cycling
through the environment, which we
Hydrological Cycle. We have enorm
resources of water on the earth am
to about 1404 million Km3.
- Every year about 1.4 inch thick laye
evaporates from the oceans, more t
of which returns to the oceans thro
hydrological cycle.

- Six countries—Brazil, Russia, Canad
  Indonesia, China, and Colombia—ac
  half of Earth's freshwater supply.
- Water poor countries : Bahrain, Jor
  Kuwait, Libyan Arab Jamahirya, Ma
  Malta, Qatar, Saudi Arabia, United A
  Emirates and Yemen.

Major River Systems in I

- 1.Indus River System.
- 2 Brahmaputra River System.
- 3 Ganga River System.
- 4 Yamuna River System.
- 5 Narmada River System.
- 6 Tapti River System.
- 7 Godavari River System.
- 8 Krishna River System.
- Ganga is the largest river of India thou also a larger river

Rivers of India

WATER USE AND OVER-EXPLO

- Water use by humans is of three types:
- 1. Water withdrawal: Taking water from groundwater or surface water resource
- 2. water consumption: The water which is but not returned for reuse – evaporated o in plants.
- 3. Hydrogen generation.
- With increasing human population and ra development, the world water withdrawa have increased many folds.
- A large proportion of the water withdraw polluted due to anthropogenic activities.

Water footprint

- **On a global average 70 percent of the**
  withdrawn is used for agriculture.
- **In India, we use 93% of water in agricu**
  sector while in a country like Kuwait, w
  water-poor, only 4% is used for wateri
  crops.
- **About 25% of water on global average**

industry, which again varies from a high
European countries to as low as 5% in les
developed countries.

Water export through crops

- India is the world's eighth largest wheat expo
  accounted for 4.1 percent of total global whea
  2020-21. Good quality wheat is produced & th
  demamd.
- India is the world's second-largest rice produc
  China, accounting for 40% of the global rice tr
  exports the grain to over 150 countries – Wat
  exported through crops (Virtual Water Export
- India has witnessed a continued decline in its
  water availability — by 60 per cent over the la
  because of increasing water use by the irrigati
- Thus, crops, meat, leather, chemicals and indu
  are imported to ensure a positive water balan

- **In USA, an average family of 4 consu**
  more than 1000 M3 of water per ye
  is many times more than that in mo
  developing countries.

Water: A Precious Natural Re

- Out of the total water reserves of the v about 97% is salty water (marine) and fresh water.
- Most of it is locked up in polar ice caps 0.003% is readily available to us in the groundwater and surface water
- Overuse of groundwater for drinking, i and domestic purposes has resulted in depletion of groundwater in various re leading to lowering of water table and wells. Water poor states in India ?

As, Fluorides, Iron, Nitrates Groundwater

- Pollution of many of the groundwater aqu made many of these wells unfit.
- Unfortunately, growth of population, has responsible for pollution of the rivers for consumption.
- Out of 8 - 9 billion people, some 2.2 billion around the world do not have safely-mana drinking water, while 4.2 billion go withou sanitation services and 3 billion lack basic handwashing facilities, according to a new from the United Nations Children's Fund (and the World Health Organization (WHO

In India people walk 5-20 kms
fetch water in some rural areas
78 meters deep even?

- **It was estimated that by 2024, two-
the world population would be suff
from acute water shortage due to in
population and industrialization-** 78

Groundwater – More wa

- **About 9.86% of the total fresh wate resources is in the form of groundw it is about 35-50 times that of surfa supplies.**
- **These are also being polluted.**
- **A layer of sediment or rock that is h permeable and contains water is ca aquifer.**

- **Unconfined aquifers - which are ov permeable earth materials and they recharged by water seeping down f above in the form of rainfall and sn**
- **Confined aquifers - which are sandv between two impermeable layers o sediments and are recharged only i areas where the aquifer intersects t surface.**

Effects of Groundwater U

- **(a). Subsidence: When groundwate withdrawal is more than its recharg the sediments in the aquifer get cor a phenomenon known as ground su There is sinking of earth and damag buildings, pipelines etc.**

(b). Lowering of water table: Mining groundwater is done extensively in ar semi-arid regions for irrigating crop fi

- The decline of groundwater levels in In
  5-10 m is usually explained as a result
  increased number of tube wells and a
  average annual rainfall.
- Haryana, Punjab ?
- Scientists using data from NASA's Grav
  Recovery and Climate Experiment (GRA
  found that the groundwater beneath N
  India has been receding by as much as
  per year over the past decade.

- **Water logging :** When excessive irri
  done with brackish water it raises th
  table gradually leading to water-log
  salinity problems.
- **Surface Water -**

This is the water coming through prec
(rainfall, snow) when this does not pe
down into the ground. Or this does n
to the atmosphere as evaporation …

or transpiration loss, assumes the form
streams, lakes, ponds, wetlands or ar
reservoirs is known as surface water.

- The surface water is largely used for
irrigation, industrial use, public wat
navigation etc.

Water Rich vs. Water Poor co

- The top 10-11 water rich countries a
  Iceland, Surinam, Guyana, Papua N
  Guinea, Gabon, Solomon Islands, Ca
  Norway, Panama, Columbia and of
  Brazil lying in the far north and have
  evaporation losses.

- The water poor countries include Kuwa
  United Arab Emirates, Malta, Jordon, S
  Arabia, Singapore, Maldovia, Israel and
  lying in the desert belt at about 15° to
  Latitude and some of them like Malta a
  Singapore are densely populated areas
  in low per capita water.

Ottawa River - The river is 1,271 km (790
it drains an area of 146,300 km2 (56,500
per cent in Quebec and the rest in Ontari

FLOODS

- In some countries like India and Banglade
  does not occur throughout the year, rathe
  is concentrated into a few months (June-S
  – Monsoon.
- Deforestation, overgrazing, mining, rapid
  industrialization, global warming etc. have
  contributed largely to a sharp rise in flood
- Cloud bursts also result in floods – Kedarn
  2013, 41 persons died., 4550 villagers affe
  Present situation this year? Cloud bursts ?
- Excess eainfall in 2025.

DROUGHTS

- There are about 80 countries in the
  lying in the arid and semiarid regior
  experience frequent spells of droug
  often extending up to year long dur

- When annual rainfall is below norm
  less than evaporation, drought cond
  created.

Causes of Drought

- **Anthropogenic causes :**
- **Over grazing, deforestation, mining**
  is spreading of the deserts tending t
  more areas to drought affected area
- **India has experienced more and mo**
  desertification, thereby increasing t
  vulnerability of larger parts of the c
  droughts – Around 70 % of area is d

- Erroneous and intensive cropping p
  and increased exploitation of scarce
  resources through well or canal irrig
  get high productivity has converted
  prone areas into desertified ones, e
  Maharashtra – 39 years and no recc
  Drought.
- Water contents of wheat and rice g

Remedial measures:

- Carefully selected mixed cropping help production and minimize the risks of c failures - For example, wheat + gram, v mustard etc. crops are selected such th nutrient requirements are different.

- Social Forestry and Wasteland develop

Eucalyptus which is now known to lower the water table because of its very high transpiration rate and it has allelopathy

CONFLICTS OVER WATER- M
deleted

- Indispensability of water and its unequ distribution has often led to inter-state international disputes.
- Water conflict in the Middle East:
- Three river basins, namely the Jordan, Tigris-Euphrates and the Nile are the s

water resources for Middle East countrie controls the head waters of 80% of Nile Egypt is being affected.

Dams and canals ?

FAO – May be delete

- India has pre-emptive right to construct b
  across all the rivers in Indian territory. Ho
  Sindhu treaty requires that the three river
  to Pakistan may be used for non-consump
  purposes by India i.e. without changing its
  quality. Recent reaction of India.

Under the IWT, (Indus Water Treaty) contro
three eastern tributaries of the Indus River–
Sutlej, and Beas—is granted to India before
into Pakistan, and the three western tributa
Jhelum, and Chenab—to Pakistan (FAO, 201

The Cauvery water dispu

- : **Out of India,s 18 major rivers, 17 are between different states.**
- **In all these cases, there are intense co over these resources which hardly seem resolve.**
- **Tamil Nadu, occupying the downstrean the river, wants water-use regulated i upstream. Whereas, the upstream stat Karnataka refuses to do so and claims over the river as upstream user.**

The Satluj-Yamuna link (SYL) dispute:

- The issue of sharing the Ravi-Beas w
  SYL issue between Punjab and Hary
- Hathnikund barrage Problem for De
- Traditional Water Management Sys
  India, even today, there are several
  where water management is done n
  Irrigation Department, but by local
  managers.

May be deleted

- In south India, a neerkatti manages traditional tanks very efficiently bas his/her knowledge of the terrain, dr and irrigation needs.
- In Maharashtra, the water manager called havaldars or jaghyas who ma resolve conflicts by overseeing the v channels from main canal to the dis canals.

BIG DAMS- BENEFITS AND PRO

- **Benefits :**
- **1. Employment for tribals.**
- **2. Checking floods and famines,**
- **3. Generate electricity and reduce w power shortage.**

4. Provide irrigation water to lower ar provide drinking water in remote area and promote navigation, fishery etc.

Environmental Problem

- **The upstream problems include the following:**
- **(i) Displacement of tribal people**
- **(ii) Loss of forests, flora and fauna**
- **(iii) Changes in fisheries and the spa laying eggs) grounds**
- **(iv) Siltation and sedimentation of r**
- **(v) Loss of non-forest land**

- (vi) Stagnation and waterlogging ne reservoir.
- (vii) Breeding of vectors and spread vector-borne diseases – Dengue ?
- (viii) Reservoir induced seismicity (R causing earthquakes.
- (ix) Growth of aquatic weeds.
- (x) Microclimatic changes.

- (B) The downstream impacts include t
  following:
- (i) Water logging and salinity due to ov
  irrigation.
- (ii) Micro-climatic changes
- (iii) Reduced water flow and silt depos
  river.
- (iv) Flash floods
- (v) Salt/soil water intrusion at river m

- (vi) Loss of land fertility along the river sediments carrying nutrients get depos reservoir.
- (vii) Outbreak of vector-borne diseases malaria, dengue etc.
- Thus, although dams are built to serve society with multiple uses, but it has s serious side-effects. That is why now t shift towards construction of small dar mini-hydel/ micro-hydel projects.

MINERAL RESOURCES

- Minerals are naturally occurring, inc
  crystalline solids having a definite c
  composition and characteristic phys
  properties – Silicates, carbonates, s
  halides, oxide etc.
- However, most of the rocks, we see
  are just composed of a few commor
  like quartz, feldspar, biotite, dolomi
  calcite, laterite etc.

- **These minerals, in turn, are composed elements like oxygen, silicon, aluminiu calcium, magnesium etc**

USES AND EXPLOITATION

- **(i) Development of industrial plants an machinery.**
- **(ii) Generation of energy e.g. coal, ligni uranium.**
- **(iii) Construction, housing, settlements**

- iv) Defence equipments - weapons, armaments.
- (v) Transportation means.
- (vi) Communication- telephone wire electronic devices.
- (vii) Medicinal system - particularly Ayurvedic System.
- (viii) Formation of alloys for various (e.g., phosphorite). – Calcium phosp

- ix) Agriculture as fertilizers, seed dres
  fungicides (e.g. zineb containing zinc,
  Maneb-containing manganese etc. is a
) – used in wheat storage and inhibitir
  of fruit.

- (x) Jewellery e.g., Gold, silver, platinur
  diamond.
- (xi) Permanent magnets of rare earthe
  Wind energy, Semiconductors etc.

Types of Minerals

- Based on their properties, minerals basically of two types:
- (i) Non - metallic minerals e.g. grapl diamond, quartz, feldspar etc.
- (ii) Metallic minerals e.g. Bauxite, la haematite etc.
- Human history periods are named a as Bronze Age and Iron Age.

- **The reserves of metals and the techni know-how to extract them have been elements in determining the economy political power of nations.**
- **Li , other rare earth elements?**
- **Out of the various metals, the one use maximum quantity is Iron and steel (74 metric tons annually) followed by man copper, chromium, aluminium and Nic**

Major reserves and importan
of some of the major met

Metal **Major World Reserves** **Major**

Aluminium : Australia, Guinea, Jamaica

Uses : Packaging food items, transportat utensils, electronics.

Chromium:

Kazakhstan, , South Africa, India

Uses : For making high strength steel alloys, In textile/tanning industries.

Cr (VI) ?

Copper:

U.S.A., Canada, Chile, Zambia

Uses :Electric and electronic goods, building, construction, vessels etc.

Iron : Australia, Brazil, Russia, China

Uses : Heavy machinery, steel production transportation means.

Lead : Australia, China, Peru , Mexico, U

- Uses : Car batteries, radiation prote paints, ammunition
- Manganese
- South Africa, Ukraine and Brazil
- Uses : For making high strength, heatresistant steel alloys..

- **Platinum**
- **South Africa, Canada, US, Zambia, Aus**
- **Uses : in automobiles, catalytic conver electronics, medical uses.**

- **Gold**
- **Australia, Russia, South Africa, Indones**
- **Uses : Ornaments, medical use, electr use in aerospace..**

- **Silver :**
- **Peru, Australia, Poland**
- **Uses : Photography, electronics , jewel**
- **Cobalt :**
- **DR Congo, Australia, Indonesia, Cuba, Philippines, Russia, Canada, Madagas USA.**
- **Uses : Aircraft engines, gas turbines, Super alloys , cemented carbides, cata**

- **Nickel :**
- **Indonesia, Australia, Brazil, Russia, Cuba, , Phili**
- **Uses : Chemical industry, steel alloys, catalysts, coins.**

Lithium : With 8 million tons, Chile has the world's known lithium reserves. This puts the South Am country ahead of Australia (2.7 million tons), Arge million tons) and China (1 million tons).

Uses : Storage batteries for solar and wind power, batteries for mobile phones, laptops, digital came electric vehicles, catalysts (La and Ce) etc.

Rare Earth Metals

- Rare-earth ore deposits are found all over
- The major ores are in China, the United St Australia, and Russia, while other viable o are found in Canada, India, South Africa, a southeast Asia.
- Rare earth elements (REEs) and rare meta ingredients for glass, lights, magnets, batt catalytic converters, and used in everythin phones to cars. For example, to make the one wind turbine, you need about 300 kil neodymium.

Rare earth and energy are re
for AI/ML in future

- Artificial intelligence (AI) depends hea
hardware made with rare earths. Thes
materials support everything from dat
to processors running complex learnin
Dysprosium and terbium boost magne
in AI-powered robots.
- The other thing this would require is e
future.
- Renewable energy also requires rare e
metals like

- Rare earth elements are key to the dev
and utilization of renewable energy te
Their properties allow the production
solar panels, electric vehicles, wind tur
energy storage devices, catalytic conve
hydrogen production.
- https://www.stanfordmaterials.com/b
-applications-of-rare-earth-elements-i
e-energy.html#:~:text=Rare%20earth%
ts%20are%20key,catalytic%20converte
and%20hydrogen%20production.

- **Wind Turbines are one of the most applications of REEs, particularly to wind energy. The production of win turbines relies on REEs, including neodymium, praseodymium, dyspro and terbium, which are used to mal high-strength permanent magnets.**
- **Rest you would learn though the As 1.**

Major uses of some non-me minerals

- Silicate minerals : Sand and gravel f construction, bricks, paving
- Limestone : Used for concrete, buil stone, used in agriculture for neutra acid soils, used in cement industry.
- Gypsum : Used in plaster wall-boar agriculture, mixing in cement.

- **Potash, phosphorite : Used as fertili**
- **Sulphur pyrites : Used in medicine, battery, metallurgical industries**

Australia, South Africa, the United Sta America, Canada, etc. are having the r world reserves of most of the metallic minerals.

- The U.S. has abundant supplies of copper, lead, iron, natural gas, tim bauxite, and uranium.
- Gold
- Rich nations ?
- Why some countries are rich ?
- India’ Golden sparrow- Padmanab temple- Thiruvanthapuram, Kerala

- **Due to huge Mineral and Energy resou Scientific and Technological advancem Maximum Nobel Prizes), the USA beca richest and the most powerful nation i world in even less than 200 years.**
- **Japan too needs a mention here, as th virtually no metal reserves, coal, oil an resources in Japan and it is totally dep other countries for its resources –**

Japan is a technologically Advanced an largest Economy of the World.

- it has developed energ efficient technologies to these resources to high quality finished produc its economy.
- Minerals are sometimes classified as Critical an for economic development.
- Critical minerals are essential for the economy e.g. iron, aluminium, copper, gold etc.
- Strategic minerals are those required for the de country e.g. Manganese, cobalt, platinum, chro
- Lithium is important for Renewable Energy sou
- Rare earth elements are essential for developin energy, transition technologies, and digitalizati technologies, such as electric motors, wind turb batteries [5]. High-tech devices, medical equipr military systems all rely heavily on rare earth e (REEs).

Some Major Minerals of India- deleted

(a) Energy generating minerals -

Coal and lignite : West Bengal, Jhark
Orissa, M.P., A.P.

Uranium (Pitchblende or Uranite ore)
Jharkhand, Andhra Pradesh (Nellore,
Nalgonda), Meghalaya, Rajasthan (Aj

Other commercially used m

- **Aluminium (Bauxite ore) :** Jharkhand, We

Maharashtra, M.P., Tamil Nadu.

Iron (haematite and magnetite ore) : Jharkl
Orissa, M.P.,A.P., Tami Nadu, Karnataka, Ma
and Goa.

- **Copper (Copper Pyrites) :** Rajasthan (Khe
  Jharkhand, Karnataka, M.P., West Bengal,
  Pradesh and Uttaranchal.

Mineral Resources Rank of

- **India's major mineral resources include C**
  largest reserves in the world), Iron ore, M
  ore and Bauxite (7th largest, Mica (8th),
  Natural gas, Diamonds, Limestone and Th
  Internet :
- **Is India rich in Mineral resources?**

https://www.google.com/search?q=Is+India+rich+in+Mineral+resources%3F+++%3A+%0D%0A
z=1C1YTUH_enIN1045IN1045&biw=1067&bih=461&sxsrf=AB5stBg2NpljOUFZTCL_qFuF-0tuMs
&ei=O3f0ZKy8DK2c4-EP98yCsAs&ved=0ahUKEwjsxcyCtI6BAxUtzjgGHXemALYQ4dUDCA8&uac
Mineral+resources%3F+++%3A+%0D%0A&gs_lp=Egxnd3Mtd2I6LXNlcnAiKUlzIEluZGlhIHJpY2gg
vdXJjZXM_ICAgOiAKMgcQIxjqAhgnMgcQIxjqAhgnMgcQIxjqAhgnMgcQIxjqAhgnMgcQIxjqAhgn
AhgnMgcQIxjqAhgnMgcQIxjqAhgnMgcQIxjqAhgnMhYQABgDGI8BGOoCGLQCGIwDGOUC2AEB
QCGIwDGOUC2AEBMhYQABgDGI8BGOoCGLQCGIwDGOUC2AEBMhYQABgDGI8BGOoCGLQCGI
DGI8BGOoCGLQCGIwDGOUC2AEBMhYQABgDGI8BGOoCGLQCGIwDGOUC2AEBMhYQABgDGI8
AEBMhYQLhgDGI8BGOoCGLQCGIwDGOUC2AEBMhYQABgDGI8BGOoCGLQCGIwDGOUC2AEBM
CGIwDGOUC2AEBSIYzUABY0ilwAXgBkAEAmAEAoAEAqgEAuAEDyAEA-AEB-AECqAIU4gMEGAA
&sclient=gws-wiz-serp: accessed oin Sept. 02, 2023.

India's merchandise export in (April-January) was USD 335.4 (B).

- Refined Petroleum ($25.3B),
- Packaged Medicaments ($17.8B),
- Diamonds ($16B),
- Rice ($8.21B),
- Jewellery ($7.57B),
- Exporting mostly to United States ($ 4
  China ($18.5B), United Arab Emirates (
  Hong Kong ($ 9.18 B), and Germany ($

ENVIRONMENTAL IMPACT
MINERAL EXTRACTION
AND USE

- **Indian Scenario : India is the produ minerals the annual value of which Rs. 50,000 crore.**

- **At least six major mines need a mer which are known for causing severe problems**

- (i) Jaduguda Uranium Mine, Jharkha exposing local people to radioactive
- (ii) Jharia coal mines, Jharkhand und fire leading to land subsidence and displacement of people.
- (iii) Sukinda chromite mines, Orissa of hexavalent chromium into river p serious health hazard, Cr 6+ being h toxic and carcinogenic.

- Kudremukh iron ore mine, Karnatak
  causing river pollution and threat to
  biodiversity.
- (v) East coast Bauxite mine, Orissa
  encroachment and issue of rehabilit
  unsettled.
- (vi) North-Eastern Coal Fields, Assar
  high sulphur contamination of grou

Impacts of mining:

Examples - Digging Sand , Gravel and Gold.

Mining is done to extract minerals (or fuels) from deep deposits in soil by us sub-surface mining or from shallow d surface mining – Kolar Gold mines.

- **The former method is more destruc dangerous and expensive including occupational hazards and accidents**

Surface mining can make use o
the following three type

- :
- (a) **Open-pit mining in which machi**
  holes and remove the ores (e.g. cop
  gravel, limestone, sandstone, marbl
  granite).
- (b) **Dredging in which chained bucke**
  draglines are used which scrap up th
  minerals **from under-water mineral**

- (c) Strip mining in which the ore is s
  off by using bulldozers, power shov
  stripping wheels (e.g. phosphate ro

- The environmental damag
  caused by mining activitie
  as follows :

- (i) Devegetation and defacing of landsc topsoil as well as the vegetation are re from the mining area to get access to t deposit.
- Large scale deforestation or devegetat to several ecological losses.
- (ii). Subsidence of land: This is mainly a with underground mining, e.g., tilting buildings, cracks in houses, buckling of

etc. .

- **(iii). Groundwater contamination :**
  disturbs the natural hydrological pr
  and also pollutes the groundwater.
- **Sulphur, usually present as an impu**
  many ores is known to get converte
  sulphuric acid through microbial act
- **Some heavy metals also get leached**
  groundwater and contaminate it po
  health hazards.

- (iv). Surface water pollution: The acid drainage/ leachates often contaminat nearby streams and lakes.
- The acidic water is detrimental to man aquatic life.
- (v) Air pollution : In order to separate the metal from other impurities in the smelting is done which emits enormou quantities of air pollutants damaging t vegetation nearby and has serious environmental health impacts. .

- **(vi) Occupational Health Hazards : the miners suffer from various resp and skin diseases due to constant e the suspended particulate matter a substances.**
- **(vii) Noise and virations.**

Remedial measures: EIA, NAB

- **Safety of mine workers should be th subject of industry.**
- **Adverse impacts of mining - Eco-fri mining technology. should be adap**
- **The low-grade ores can be better ut using microbial-leaching technique *Acidithiobacillus ferrooxidans* which more environment friendly.**

- **Restoration of mined areas by re-ve**
  them with appropriate plant specie
  stabilization of the mined lands, gra
  restoration of flora, prevention of t
  drainage discharge and conforming
  standards of air emissions are esser
  minimizing environmental impacts

LAND RESOURCES

- LAND AS A RESOURCE
- Land is a finite and valuable resource u
  we depend for our food, fiber and fuel
  basic amenities of life.
- Soil, especially the top soil, is classified
  renewable resource because it is conti
  regenerated by natural process though
  slow rate.
- About 200-1000 years are needed for t
  formation of one inch or 2.5 cm soil, d
  upon the climate and the soil type.

Country with most arable

- Arable land is defined by the United N
  Food and Agriculture Organization (FA
  currently used, or potentially capable
  used, to grow seasonal crops (Arable A

In Acres	
United States	389,767,633
India	385,641,557
Russia	300,594,679
China	295,220,748

Green Revolution in India-

- Land use statistics by country
- Rank Country Arable land (%)
- 1 India 50.4
- 2 United States 16.8
- 3 Russia 7.3
- 4 China 11.3,
- Adoption of technology, such as the u yielding variety (HYV) seeds, mechaniz tools, irrigation facilities, pesticides, ar fertilizers.- Normam Borlaug – Dwarf v variety.
- ,,,,,,,,,,,,,

Explained before ?

Rank	Country	Arable Hectares	Arable He
1	United States	157,736,800	389,767,633
2	India	156,067,000	385,641,557
3	Russia	121,649,000	300,594,679
4	China	119,474,200	295,220,748
5	Algeria	75,050,017	185,448,592
6	Brazil	55,762,000	137,787,902
7	Nigeria	34,000,000	84,014,000
8	Ukraine	32,924,000	81,355,204
9	Argentina	32,632,760	80,635,550
10	Australia	30,573,000	75,545,883

Total Areawise countries

Algeria **185,448,592**

(https://worldpopulationreview.com/country-rankinnd-by-country, Accessed on Septamber 09, 2022).

Total Areawise countries :

1. Russia. Area: 17,125,000 square kilometres.

2. Canada. Area: 9,984,670 square kilometres.

3. China. Area: 9,572,900 square kilometres.

4. United States of America. Area: 9,525,067 squar

5. Brazil. Area: 8,515,767 square kilometres. ...

6. Australia. ...

7. India. ...

8. Argentina

LAND DEGRADATION

- With increasing population growth
  demands for arable land for produc
  fibre and fuelwood is also increasin
- More population more land degrad
  to overexploitation.
- The average annual erosion rate is
  times more than the renewal rate.

Degradation of Land

- Soil erosion, water-logging, salinizat
  contamination of the soil with indus
  wastes like fly-ash, press-mud or he
  metals all cause degradation of land
- SOIL EROSION
- Soil erosion results in the loss of fer
  top soil layer.
- Two thirds of the seriously degrade
  in Asia and Africa.

Type of Soil Erosion

- Soil erosion is of two types
- (i) Normal erosion or geologic erosi
  caused by the gradual removal of to
  natural processes. There is a balanc
  between erosion and renewal.
- (ii). Accelerated erosion: This is mai
  caused by anthropogenic (man-mad
  activities and the rate of erosion is r
  faster than the rate of formation of

- **Overgrazing, deforestation and mining important activities causing accelerated**
- **AGENTS OF SOIL EROSION :**
- **There are two types of agents which ca erosion:**
- **(i) Climatic agents: Water and wind are climatic agents of soil erosion. Water a erosion in the form of torrential rains, of water along slopes, run-off, wave act melting and movement of snow/ice.**
- **(ii). Biotic agents: Excessive grazing, mi deforestation are the major biotic agen responsible for soil erosion.**

The 7 methods of soil cor

- **These methods include**
- **(1). Installing biodegradable erosion co mats,(2).Practicing crop rotation, (3). implementing conservation tillage,(4). farming, (5). strip farming,(6). terrace f and (7). using diversion structures.**
- **Preventing soil erosion is essential for maintaining soil health, crop yield, and ecosystems.**

SOIL CONSERVATION PRACTICEMay be d

- **(i) Conservational till farming:**

or minimum tillage, is a broadly defined
that includes no-till, strip till, ridge till, ar
till systems. These techniques maintain p
residues (mulch) of previous crop on at
of the soil surface after tillage activities.

Conservation tillage,

May be deleted

Inject seeds, fertilizers, herbicides and
water in the slit, so that the seed germ
and the crop grows successfully witho
competition with weeds.

(ii) Contour farming: On gentle slopes
are grown in rows across, rather than
down, a practice known as contour fa

Each row planted horizontally along t
of the land.

May be deleted

- **Terracing :**

It is used on still steeper slopes. These a converted into a series of broad terraces across the contour.

(iv) Strip cropping: Here strips of crops ar alternated with strips of soil saving cover grasses or grass-legume mixture. Whatev comes from the cropped soil is retained b of covercrop and this reduces soil erosion fixing legumes also help in restoring soil

Fallow land – Land left wit
cropping to gain nutrien

- (vi) Alley cropping: It is a form of inter-
in which crops are planted between ro
trees or shrubs. This is also called Agro

Water Logging

- In order to provide congenial moisture
growing crops, farmers usually apply h
irrigation to their farmland. Also, in or
leach down the salts deeper into the s
farmer provides more irrigation.

LANDSLIDES

- Various anthropogenic activities like hydroelectric projects, large dams, res construction of roads and railway lines construction of buildings, mining etc a responsible for clearing of large forest
- These result in landslide.

They also increase the turbidity of variou streams, thereby reducing their producti

About 29.32 % land degradati desertification in India - 2

- DESERTIFICATION
- Desertification is a process whereby the p potential of arid or semiarid (receiving les lands falls by ten percent or so.
- Severe desertification results in more than in productivity and usually creates huge g sand dunes.
- Desertification leads to the conversion of i.e., grasslands or irrigated croplands to d conditions in which agricultural productivi

Desertification

- **Desertification is characterized by devegetation and loss of vegetal ov depletion of groundwater, salinizati severe soil erosion.**

Causes of Desertification:

Formation of deserts may take place

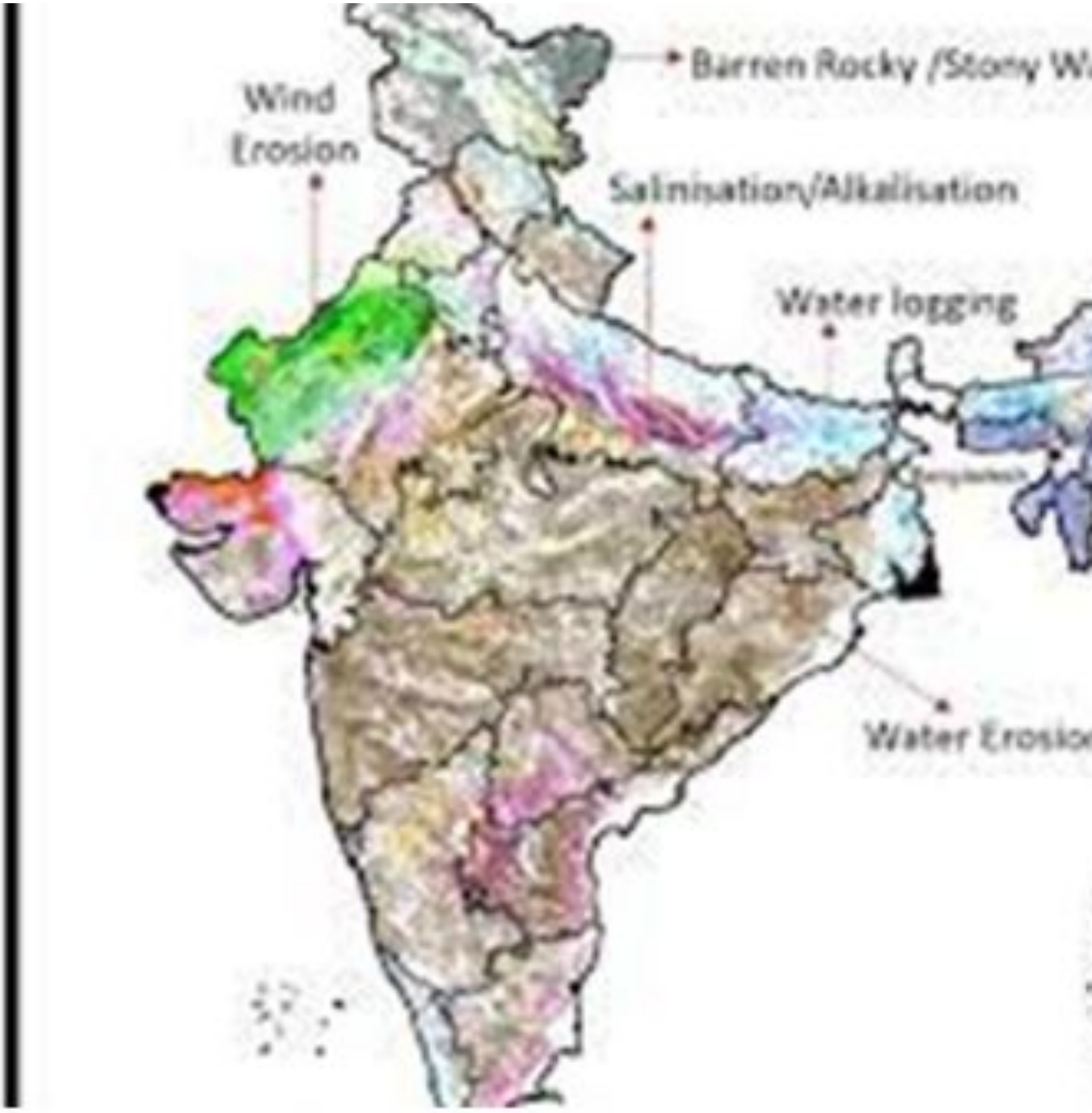
(1). Due to natural phenomena like cli change or may be due to abusive use of land. (2). Anthropogenic activi

The major anthropogenic act
responsible for desertifica

- (a) Deforestation:
- (b) Overgrazing
- :(c) Mining and quarrying.
- Xenobiotics are chemical substances that are
  animal life and thus includes such examples as
  constituents, drugs, pesticides, cosmetics, flav
  fragrances, food additives, industrial chemical
  environmental pollutants.

THERE IS A NEED OF INDIVIDUAL EFFOTS IN THE CONSERVATION OF NATURAL RESOURCES.

Map of Desertification in India -


Barren Rocky /Stony W
Wind Erosion
Salinisation/Alkalisation
Water logging
Water Erosio

Conserve Water

Do not keep water taps running while b
shaving, washing or bath in the fountains

In washing machines fill the machine onl
level required for your clothes.

l Install water-saving toilets that use not
6 liters per flush.

l Check for water leaks in pipes and toile
repair them promptly. A small pin-hole s
will lead to the wastage of 640 liters of w
month.

- l Reuse the soapy water of washing clothes for washing off the courtyar driveways etc.
- l Water the plants in your kitchen-g the lawns in the evening when evap losses are minimum. Never water
- the plants in mid-day.
- l Use drip irrigation and

and sprinkling irrigation to improve irrigation efficiency and reduce evapo

- l Install a small system to capture ra and collect normally wasted used w sinks, cloth-washers, bathtubs etc. w be used for watering the plants.
- l Build rain water harvesting system house. Even the President of India i this.

ENERGY RESOURCES

- Energy consumption of a nation is u considered as an index of its develo
- This is because almost all the develo activities are directly or indirectly d upon energy.
- Early man used it for cooking and h purposes. Wind and hydropower ha been in use for the last 10,000 year
- Germany – Falling water

- **The invention of steam engines repl**
  burning of wood by coal and coal w
  replaced to a great extent by oil. In
  to Yom –Kippur War and Iranian rev
  and Oil Politics – there was Oil Crisi
- **Due to Arab oil embargo the prices**
  up. This ultimately led to explorati
  of several alternate and nonconveti
  sources of energy - CES

GROWING ENERGY NE

- Agriculture, industry, mining, transportati
  cooling and heating in buildings all need e

- With INCREASE IN population the world i
  further energy deficit. The fossil fuels like
  and natural gas which at present are supp
  ALMOST 80 - 90% of the commercial energ
  world resources are not going to last for
  years.
- Our life style is changing very fast and fro
  way of life we are shifting to a luxurious li

- **Developed countries like U.S.A. and constitute about 5% of the world,s population but consume one fourth energy resources.**
- **An average person there consumes (Giga Joules,equal to 60 barrels of o year. By contrast, an average man i country like Bhutan, Nepal or Ethiop consumes less than 1 GJ in a year.**

- **Global energy demand rose by 2.2% in reaching nearly 650 EJ.**
- **In 2023, India's primary energy consun listed as the third largest in the World, exajoules (EJ) behind China (170.74 EJ) USA (94.28 EJ). Per person, energy con in India is 27.3 gigajoules (GJ) compare GJ in China and 277.3 GJ in US in 2023.**

Exajoule is equal to 10 raised to the pow joules

90 % villages in India elect

- Today, India is the third largest energy co
  the world.
- India has large population and Rural popu
  total population) in India was reported at
  2021 - according to the World Bank collec
  development indicators, compiled from o
  recognized sources.
- As of June 2025, India's total installed pow
  has reached a significant milestone with 4
  by 240 GW of thermal, 110.9 GW of solar,
  GW of wind power, marking a strong shift
  renewable energy and energy security.

RENEWABLE AND NON-RENE
ENERGY SOURCES

- Renewable Resources which can be generated continuously in nature ar inexhaustible e.g. wood, solar energ energy, tidal energy, hydropower, b energy, biofuels, geothermal energy hydrogen.
- They are also known as non-conven sources of energy and they can be u and again in an endless manner

Non-renewable Energy Res

- **Non-renewable Resources which ha accumulated in nature over a long s time and cannot be quickly replenis exhausted e.g. coal, petroleum, nat**

and nuclear fuels like uranium and t

It took millions of years for the coal to formed out of wood and petroleum a gas to be formed from the dead mari animals.

(a) Renewable Energy Res

- **Solar energy: Sun is the ultimate sourc energy, directly or indirectly for all oth of energy.**
- **Our Sun is about halfway through its li don't worry. It still has about 5,000,000,000—five billion—years to g**
- **The solar energy received by the near space is approximately 1.4 kilojoules/s known as solar constant.**

Solarimeter - is a pyranometer, a t
measuring device used to measure c
direct and diffuse solar radiati

- **Traditionally, we have been using sola**
  for drying clothes and food-grains, pre
  of eatables and for obtaining salt from
- **Solar heat collectors :**
- **These can be passive or active in natur**
  solar heat collectors are natural mater
  stones, bricks etc. or material like glass
  absorb heat during the day time and re
  slowly at night. Glaubers salt - Sodium
  decahydrate (32 deg. C).

- **(iii) Solar cooker:**
- **Solar cookers make use of solar heat by re solar radiations using a mirror directly on sheet which covers the black insulated bo which the raw food is kept .**
- **(iv) Solar water heater:**
- **It consists of an insulated box painted bla inside and having a glass lid to receive and heat. Inside the box it has black painted co through which cold water is made to flow gets heated and flows out into a storage t**
- **The hot water from the storage tank fitted top is then supplied through pipes into bu hotels and hospitals.**

Active solar collectors pump a heat absorbi
medium (air or water) through a small colle
is normally placed on the top of the buildin

Solar cells/ PV cells :

They are also known as photovoltaic cells c
Solar cells are made of thin wafers of semi
materials like silicon. When solar radiation
them, a potential difference is produced wh
flow of electrons and produce electricity. –
junction.

Doping of solar cells

- **Usually silicon is used in two layers, or being doped with boron, the other pho These layers have different chemical e charges and subsequently both drive a the current of electrons.**
- **Phosphorus is n –type dopant, others -**

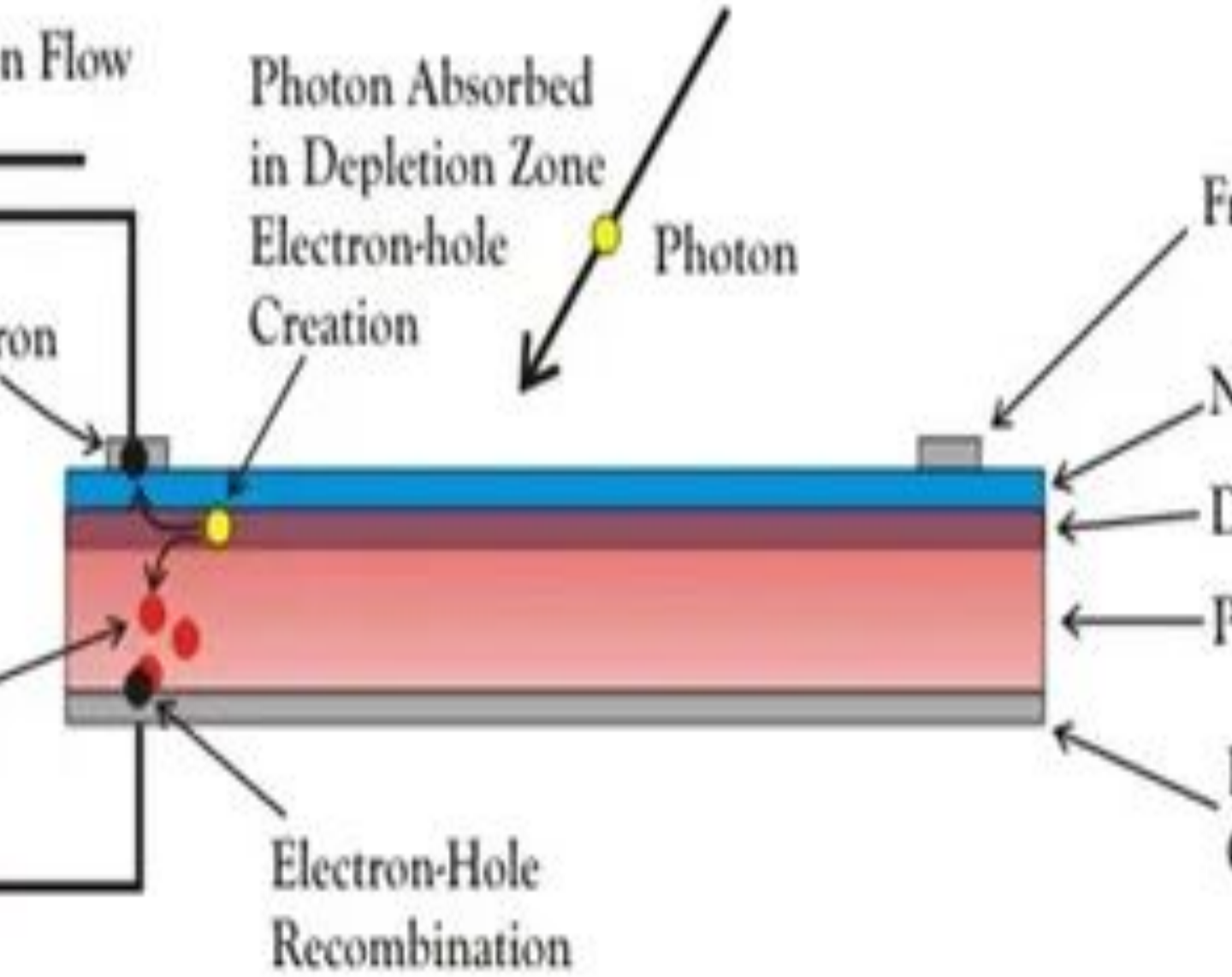
- (For generating electrons) .

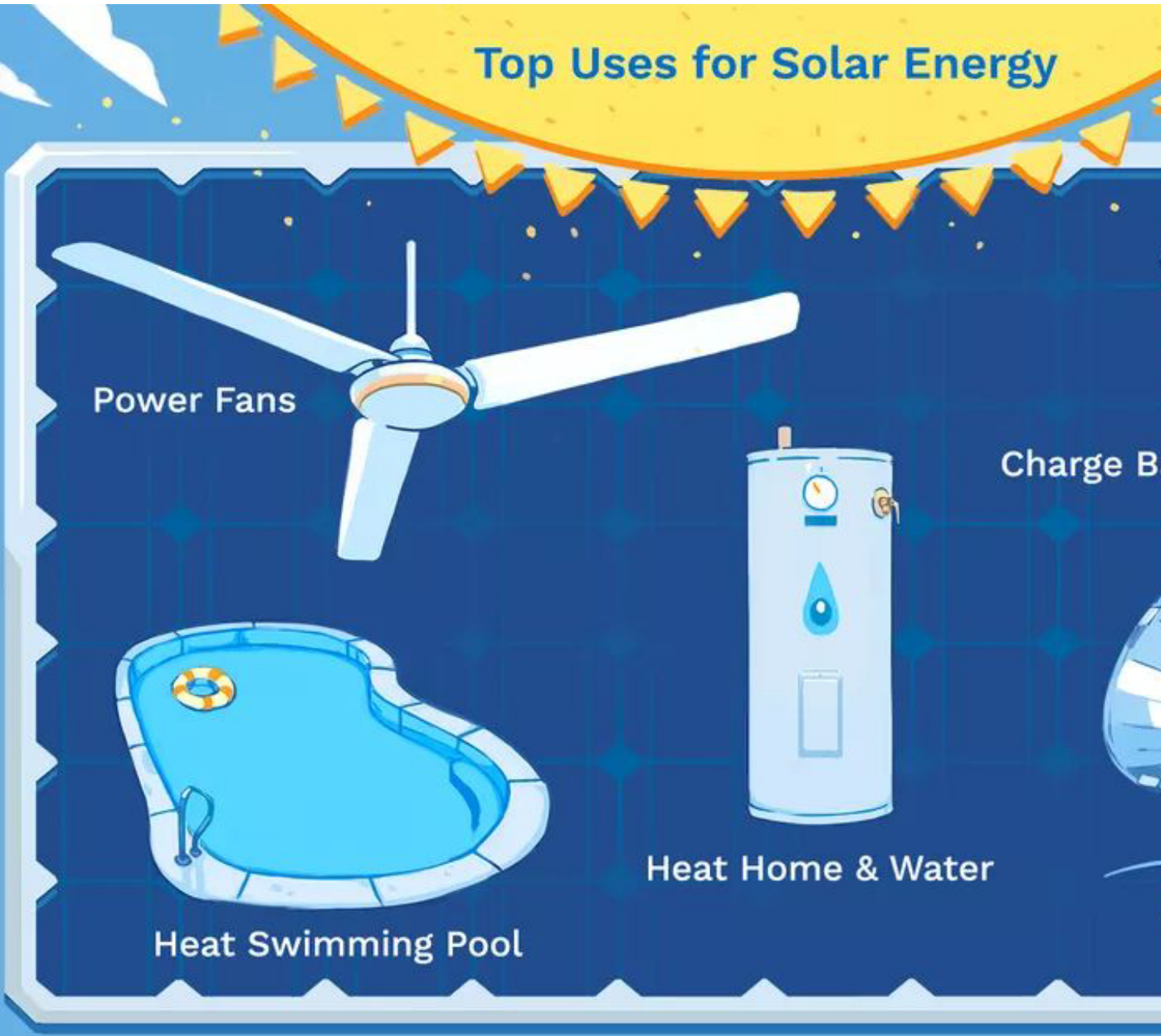
- **Boron is a p-type dopant, other is Indiu**

- (For moving positive holes to the n – ty receiving electrons from the p- type dope semiconductor).

- **N-type materials increase the conductiv semiconductor by increasing the numbe available electrons; P-type materials in conductivity by increasing the number present.**

- **P-N junctions are formed by joining n-ty p-type semiconductor materials, as sho figure in the next slide. Since the n-typ has a high electron concentration and t a high hole concentration, electrons dif the n-type side to the p-type side.**


n Flow
ron
Photon Absorbed
in Depletion Zone
Electron-hole
Creation
Photon
Electron-Hole
Recombination


Top Uses for Solar Energy
Power Fans
Heat Home & Water
Charge B
Heat Swimming Pool

Video on photovoltaic pow generation

- https://www.google.com/search?q=video+on+photovo%3
neration+&sca_esv=5b71cfa89013eb9f&rlz=1C1YTUH_enI
xsrf=AE3TifP6eQMTH8lrMnA5swvxl_DoxK1Obw%3A1757
1DIaKDjIZeqseMPls_02Qo&ved=0ahUKEwjgyu3AqNuPAxU
sQ4dUDCBA&uact=5&oq=video+on+photovo%3Btaic+pow
&gs_lp=Egxnd3Mtd2l6LXNlcnAiJ3ZpZGVvIG9uIHBob3Rvdm
dlciBnZW5lcmF0aW9uIDIHECEYoAEYCjIHECEYoAEYCjIFECE
FSPuRAVAAWOOMAXABeAGQAQCYAbQBoAHmLaoBBDAu
4AQGYAiigArcvqAIKwgIHECMYJxjqAsICChAjGIAEGCcYigXC
AAYgAQYkQIYigXCAgsQABiABBixAxiDAcICCBAAGIAEGLEDw
PCAggQLhiABBjlBMICChAAGIAEGEMYigXCAgsQLhiABBixAx
EGLEDGEMYigXCAgUQABiABMICChAAGIAEGAIYywHCAgcQ
EAAYDRgewgIIEAAYCBgNGB7CAgsQABiABBiGAxiKBcICBA
EAAY7wWYAw3xBa-Si7ulAXoikgcEMS4zOaAHxIACsgcEMC
wLjE5LjE4LjPIB60B&sclient=gws-wiz-serp#fpstate=ive&vld
id:FQXkMt0Zm1A,st:0

Use of Fresnel lenses also

- The use of Fresnel lens is to magnify the li
  intensity from the sun to achieve higher s
  collectability of solar panel which may inc
  power output.

(v) Solar furnace:

Here thousands of small plane mirrors are a
concave reflectors, all of which collect the so
and produce as high a temperature as 3000°

One may use concentrating lenses also but c
upon the economy.

Use of solar energy for solvent extractors an
reactions at IIT Delhi.

- **(vi) Solar power plant :**
- **Solar energy is harnessed on a large scale**
  concave reflectors/ solar concentrators w
  boiling of water to produce steam. The st
  drives a generator to produce electricity.
  power plant (50 K Watt capacity) has bee
  at Gurugram, Haryana.

Several solar photovoltaic systems are being
India lately at Karnataka, Telengana, Rajath
Pradesh and Gujarat (Bhuj) etc.

- The Bhadla Solar Park is a solar power pla
in the Thar Desert of Rajasthan, India. It c
area of 56 square kilometers and has a tot
capacity of 2,245 megawatts (MW), makir
largest and the 11th-largest solar park in t
of 2024.
- The NTPC REL. Khavda Solar Park (NTPC R
Energy Ltd.) is set to surpass the Bhadla S
the biggest solar power plant in India, wit
proposed capacity of 4,750 MW. The cons
this facility is currently underway in Bhuj,

As of July 2025, India's cumulative solar power ca
at 119.02 GW, which includes 90.09 GW from gro
solar plants, 19.88 GW from grid-connected roof
3.06 GW from hybrid projects, and 5.09 GW from
installations, reflecting the country's diverse a
expanding

WIND ENERGY

- **The high speed winds have a lot of e**
  them as kinetic energy due to their
  The driving force of the winds is the
  wind energy is harnessed by making
  wind mills. The blades of the wind m
  on rotating continuously due to the
  the striking wind.

Height –10 – 200 mete

- **These wind farms are ideally located in coa regions, open grasslands or hilly regions, p mountain passes and ridges where the wir strong and steady. The minimum wind spe for satisfactory working of a wind generato km/hr.**
- **Global status: India has fourth largest wind installed capacity and is third largest renew energy producer in the world. Significant g From 21.04 GW in 2014 to 51.5 in May 202 Renewable Energy: Wind power is the seco contributor to India's renewable energy m solar pow**

Wind Mills in India

HYDROPOWER

- The water flowing in a river is collected by constructing a big dam where the water is allowed to fall from a height.
- The blades of the turbine located at the b the dam move with the fast moving water turn rotate the generator and produces el Faradays law of Induction.
- The hydropower potential of India is estim about 4 × 10 raised to the power 11KW-ho
- Till now we have utilized only a little more of this potential.

Hydroelectric Power Gewn

TIDAL ENERGY

- Ocean tides produced by gravitational
  sun and moon contain enormous amou
  energy. The high tide and low tide refe
  rise and fall of water in the oceans.
- There are only a few sites in the world
  tidal energy can be suitably harnessed
  of Fundy Canada having 17-18 m high t
  potential of 5,000 MW of power gener
- Wave energy can also be used for pow
  generation.

- **The tidal mill at La Rance, France is first modern tidal power mill.**
- **In India Gulf of Cambay, Gulf of Kut the Sunder bans deltas are the tidal sites.**

OCEAN THERMAL ENERG CONVERSION (OTEC)

- The energy available due to the differe temperature of water at the surface of tropical oceans and at deeper levels is Ocean Thermal Energy. A difference of more is required between surface wate deeper water of ocean for operating O (Ocean Thermal Energy Conversion) po plants.
- The warm surface water of ocean is us a liquid like ammonia.

- **The high pressure vapours of the liq formed by boiling liquid are then us the turbine of a generator and prod electricity – Rankine cycle.**
- **The colder water from the deeper o pumped to cool and condense the v into liquid. Thus the process keeps c continuously for 24 hours a day.**

The ten countries with the most renewable energ
Norway, Sweden, Brazil, New Zealand, Denmar
Switzerland, Finland, and Colombia

- **Renewables 2022 Global Status Report**
  India Ranks Third Globally, After China
  For Total Renewable Power Addition In
- **As per IRENA RE Statistics 2025, India r**
  globally in Renewable Energy Installed
  4th in Wind Power, and 3rd in Solar Po
  capacity. Expansion in Renewable Ener
  Capacity: Installed RE capacity has grow
  76.37 GW in March 2014 to 226.79 GW
  2025, an increase of nearly 3 times.

GEOTHERMAL ENERG

- The energy harnessed from the hot present inside the earth is called ge energy. High temperature, high pres steam fields exist below the earth's many places.
- In some places, the steam or the ho comes out of the ground naturally t cracks in the form of natural geyser Manikaran, Kullu and Sohna, Harya

Jharia ?

- In USA and New Zealand, there are
  geothermal plants working successf

BIOMASS ENERGY

(a) Energy Plantations:

Fast growing trees like cottonwood, p
Leucaena, non-woody herbaceous gra
plants like sugarcane, sweet sorghum
sugar beet, aquatic weeds like water

and sea-weeds and carbohydrate rich
cereal etc. are some of the important
plantations.

- (b) Agricultural and Urban Waste bi
  Crop residues, bagasse (sugarcane r
  coconut shells, peanut hulls, cotton

etc. are some of the common agricultu
wastes which produce energy by burn

- **Animal dung, fishery and poultry waste human refuse are examples of biomass**
- **In Brazil 30 % of electricity is obtained burning bagasse.**
- **In rural India, animal dung cakes are bu produce heat. About 80 % of rural hea requirements are/ were met by burni agricultural wastes, wood and animal – CBG and LNG Cylinders.**

Compressed BIOGAS Cyli

- Biogas is a mixture of methane, carbon hydrogen and hydrogen sulphide, the constituent being methane. Biogas is p by anaerobic digestion of animal wast times plant wastes) in the presence of
- Biogas plants used in our country are b two types:
- 1. Floating gas-holder type and 2. Fixed type- Compressed Biogas – Removal of

Biogas Plant in India

BIOFUELS

- Ethanol can be easily produced from carbohydrate rich substances like su It burns clean and is non-polluting.
- However, as compared to petrol its value is less and therefore, produce less heat than petrol.
- Methanol is very useful since it burn lower temperature than gasoline or

One hundred years ago, Rudolf Diesel tested pean for his engine for the first time on August 10, 1 1930s and 1940s vegetable oils were used as dies time to time, usually only in emergenc

- **Biodiesel and Green Diesel :**
- **From seed oils : Sunflower oil, Soyabean c oil, Jatropha oil, Pongamia oil etc.**
- **Waste cooking oil.**
- **HYDROGEN AS A FUEL**
- **Electrolysis of water using power generate renewable energy.**
- **Green Hydrogen.**
- **Blue Hydrogen**
- **Brown Hydrogen**
- **Pink Hydrogen.**

b) Non-Renewable Energy S

- **COAL**
- **Coal was formed 255-350 million ye the hot, damp regions of the earth d carboniferous age.**
- **At the present rate of usage, the co reserves are likely to last for about and if its use increases by 2% per ye will last for another 65 years?**

- **Peat**
- **Lignite/ Brown coal. Bituminous coa**
- **Anthracite**
- **Production of coal during 2022-23 w MT (Provisional) with a positive gro 8.67%.**

- India has almost 9% of the world's tota reserves and it has 360 Billion tons).

- Major coal fields in India are Raniganj, Jharia, Bokaro, Singrauli, and Godavari v

Coking coal is mainly imported in India. A million tons of coking coal is imported by almost same amount was produced by In

Coal Capital - Dhanba

- **The coal states of India**

are Jharkhand, Orissa, West Bengal, M
Pradesh, Andhra Pradesh and Mahara
Anthracite coal occurs only in J & K.

- **When coal is burnt it produces carb dioxide, which is a greenhouse gas responsible for causing enhanced gl warming. Fly ash is also produced.**
- **There are clean coal technologies.**

- **Coal also contains impurities like sulph therefore as it burns the smoke contai gases like oxides of sulphur and nitrog**

- **PETROLEUM**
- **It is the lifeline of global economy. The countries in the world having 67% of t petroleum reserves which together for OPEC (Organization of Petroleum expo countries). About 1/4th of the oil reser Saudi Arabia.**

Petroleum Refining

- At the present rate of usage, the world's c reserves are estimated to get exhausted i years. Some optimists, however, believe t are some yet undiscovered reserves. Even crude oil reserves will last for another 40- so.

Crude petroleum

- Crude oil is a complex mixture of alkane a hydrocarbons. Hence it has to be purified by the process of fractional distillation, du process different constituents. – Gasoline, ATF etc. are produced.

Refining – Removing S and
impurities from crude o

- Oil fractions separate out at different
temperatures. (Petroleum refineries)
large variety of products from this, nar
petroleum LPGs, kerosene, petrol, die
oil, lubricating oil, paraffin wax, aspha
etc - Petrochemicals
- Petroleum is a cleaner fuel as compare
as it burns completely and leaves no re
also easier to transport and use. That i
reason why petroleum is preferred am
the fossil fuels – IOCL. HPC, BP etc.

Liquefied petroleum gas (

- The main component of petroleum
  the other being propane and ethan
  petroleum gas is easily converted to
  form under pressure as LPG.

NATURAL GAS

It is mainly composed of methane (95
small amounts of propane and ethane

Shale gas (70-90 % methane) from s
formations.

- It is a fossil fuel. Natural gas deposit
  accompany oil deposits because it h
  formed by decomposing remains of
  animals and plants buried under the
- Natural gas is the cleanest fossil fue
  be easily transported through pipeli
  has a high calorific value of about 3
  MJ/m3 and burns without any smol

LNG imported and used a

- Russia has maximum reserves (40 %
followed by Iran (14%) and USA (7%
- Natural gas reserves are found in as
with all the oil fields in India. Some
fields have been found in Tripura, Ja
Off-shore area of Mumbai and the K
Godavari Delta - ONGC and GAIL.

NUCLEAR ENERGY

- Nuclear energy is known for its high destructive power as evidenced fro weapons. The nuclear energy can al

harnessed for providing commercial e

Nuclear energy can be generated by t of reactions:

- (i) Nuclear Fission: It is the nuclear c which nucleus of certain isotopes w mass numbers are split into

Nuclear Fuels

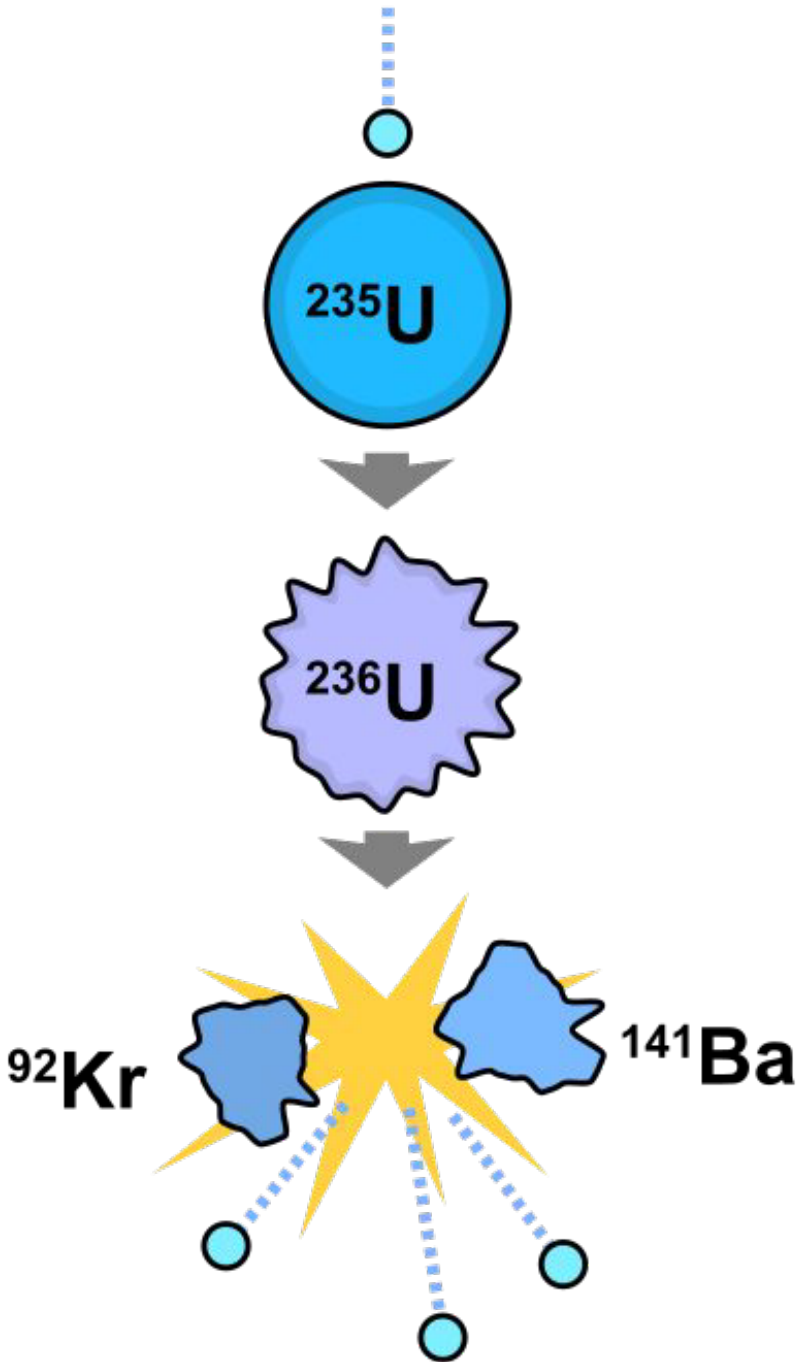
lighter nuclei on bombardment by neu
and a large amount of energy is releas
through a chain reaction

- 92U235 + 0n1 → 36Kr92 + 56Ba141
  Energy

- U 238 + 0 Nu 1 = Pu 239 + Energy

- **A typical nuclear power plant in ope today uses about 2 kg Uranium-235 generate 1000 megawatts of electri**

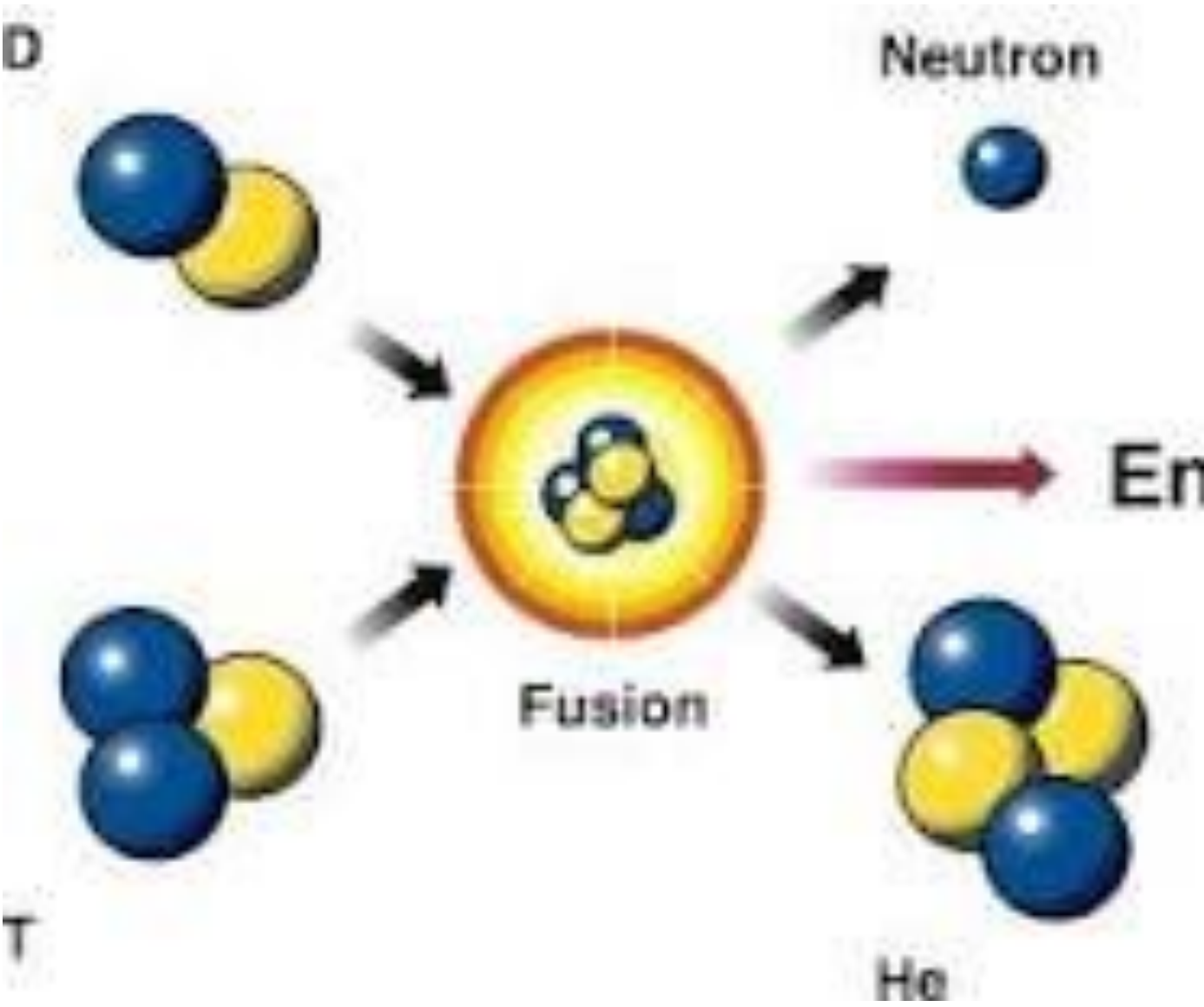
- **About 5600 tons (5.1 X 10 raised to power 6 kg) of coal are required to the same amount of electricity in a conventional power plant.**
- **Presently, India has 22 operating nu reactors, with an installed capacity MWe.**


^{235}U
^{236}U
^{92}Kr
^{141}Ba

(ii) Nuclear fusion:

- Here two isotopes of a light element a
together at extremely high temperatu
billion °C) until they fuse to form a hea
nucleus releasing enormous energy in
process. It is difficult to initiate the pro
releases more energy than nuclear fiss
Chaos- Containment of heat
- There are around 20 fusion reactors ir
world, all striving to reach the extreme
temperatures needed and R & D work
progress.

- **Nuclear Fusion reactions power the other stars. In a fusion reaction, two nuclei merge to form a single heavier nucleus. The process releases energy the total mass of the resulting single is less than the mass of the two original nuclei. The leftover mass becomes e**


D
Neutron
Fusion
T
He

Present Energy Scenar

- Present trend is to go in for the cleaner re
  energy sources such as solar energy mainl

- Use of Electrical vehicles is being encourag
  may be fueled by Fuel cells and Hydrogen
- During COP 21 at Paris some voluntary co
  to reduce CO_2 emissions were made - Na
  Determined Contributions (NDCs) - Lifesty
  Environment' as a key to combating clima

What is India's NDC target by

- India's NDC has three main elements:
- An emissions-intensity target of 45% b levels by 2030.
- A target of achieving 50% cumulative power installed capacity from non-foss fuel-based energy resources by 2030.
- Hon'ble Prime Minister's vision of sust lifestyles and climate justice to protect and vulnerable from adverse impacts c change

EQUITABLE USE OF RESOURC
SUSTAINABLE LIFE STYLE – Background Inform

- There is a big divide in the world as North the more developed countries (MDC's) an developed countries (LDC's),the haves and nots..
- The MDC's have only 22% of world's popu they use 88% of its natural resources, 73% energy and command 85% of its income. I contribute a very big proportion to its poll
- These countries include USA, Canada, Japa Australia , New Zealand and Western Euro Countries.

- **The LDCs on the other hand, have v moderate industrial growth, have 7 world population and use about 12 natural resources and 27% of energ income is merely 15% of global inco gap between the two is increasing w due to sharp increase in population LDC's. The rich have grown richer w poor have stayed poor or gone even**

- **As the rich nations are developing m are also leading to more pollution a sustainability of the earth's life supp system is under threat.**
- **As the rich nations continue to grow will reach a limit. If they have a grow of 10 % every year, they will show 1 increase in the next 70 years or so.**
- **Will this much of growth be sustain**

- **Thus, the two basic causes of unsus**
  are over population in poor countri
  have under consumption of resourc
  over consumption of resources by t
  countries, which generate wastes.
- **In order to achieve sustainable life s**
  desirable to achieve a more balance
  equitable distribution of global resc

income to meet everyone's basic nee

Top 10: Sustainable Count

- Canada.
- Germany.
- Norway.
- Switzerland.
- Finland.
- Rural Sweden.
- Stockholm, Sweden.
- Denmark.