MODULE- 6
NON NEUCLEAR ENERGY

TOPICS

- Energy Environment Linkage
- Clean Coal Tech
- Energy Efficiency — Smart Grid
- Solar Power — JNNSM, ISA, NCEF, Misc.
- Waste to Energy
- Biofuel
- Hydrogen Fuel
- Shale Gas, CBM, Gas Hydrate

ENERGY ENVIRONMENT LINKAGE

→ 60% of energy is dependent on environment
→ Climate change → Global warming (14.2°C | 15.03°C - Average Temperature Stabilisation Rate) increased
→ we're moving towards 6th Mass Extinction.
→ Cause of GW → Green House Effect. 16°C max (we have 2°C margin left)
Trapping of heat radiation by the atmospheric gases
→ Consequences of GW → Vector Born Disease e.g. Dengue ↑ 50x (in 30 years)
→ Psychological Aspect e.g. PTSD, Depression
→ Landslides
→ Soil salinity

1992 EARTH SUMMIT, Rio De Jeneiro ← UNFCCC, CCD, CBD

⇒ **UNFCCC** →

- Adopted in 1992, came into force in 1994.
- It is in Top Down in nature.
- Some provisions legally binding and some are not.
- Talks about. **Mitigation** → reduction of emission of GHG
  e.g. Metro, Planting trees, ~~etc~~ solar power etc
  Griha Code (HVAC)
- **Adaptation** → Minimising impact of climate change
  e.g. SHCs, forecasting, address growth of mosquitos.
- **Finance** → Industrialised countries will finance for mitigation & adaptation.
- **TOT** → CBDR (Common But Differenciated Responsibility) all countries participate acc to their capacity

Historical Responsibility
Equity
Climate Justice
polluter pays

→ 1995 → Conference of Parties started.
→ At the third COP held in 1997 at Kyoto, a protocol was adopted.

KYOTO PROTOCOL

→ For the period - 1998-2012 → 1st Commitment Period
- 2013-2020 → IInd " "

→ Kyoto Protocol is top down in nature
→ " " legally binding
→ " " based on CBDR → countries are classified into four categories

Annex-1 - Industrialised nations and economies in Transition.
- mandatory to reduce GHG emission.
• finance & tech for [Mitigation]

Annex 1
Industrialisation Nations

Non Annexed
can't be forced to ↓ emissions
Developing countries
← Mitigation
← Adaptation

LDC's
~~Too should~~
finance & tech for Adaptation

→ KP talks about mitigation
→ " " " Market Mechanism → Carbon Trading / Emission Trading.
→ Joint Implementation
→ clean development mechanism

→ Annex I countries should reduce GHG emissions
• 1990 as a base year by 5.2%, in 2008-12
• 14.5% 2013-2020

→ In USA, Republicans do not believe in climate change.
→ This is why Kyoto Protocol was hatted.

3 MECHANISMS UNDER KYOTO PROTOCOL

① CLEAN DEVELOPMENT MECHANISM - when an Annex I country invest in a non-Annex countries in a project which result in emission reduction.

→ Annex I country is given Carbon Credit at the rate of 1 Carbon Credit for every 1 tonne of emission reduction → which can use for covering the domestic emissions or to sell them in international market through Carbon Trading.
→ CDM ensure TOT, it is having Adaptation fund which receives 2% of the total amount generated from the trading of the Carbon Credit.

→ But the flip side is → Only the pollutee changes.
→ Pollution remains the same
→ India and China is accounting for more than half of projects and the remaining developing countries are accommodated is less than half
→ Distribution of projects is skewed.

(2) **JOINT IMPLEMENTATION** → when Annex I county carries out investment in another Annex 1 county in a project which results in emission reduction.
→ Carbon credits are called ERUs (Emission Reduction Units) used in same manner as they Certified emission reduction Units of CMD were utilised.
→ In terms of impact joint implementation is not prominent b/c the annex 1 economies are not growing at the desired rate, consequently they are not even exhausting their assigment Amount of units

(3) **CARBON TRADING / EMISSION TRADING / CAP IN TRADE**
→ Countries from Annex 1 have assigned amounts of units i.e, Maximum Emission they can have in a year.
→ If a country is able to restrict its emissions within the prescribed limit, it receives carbon credits which are purchased by the country which has exceeded its max emission limit.
→ Initially Carbon Trading was restricted among the Annex I countries but now buyers are still annex 1 but sellers can be non-annex countries.

3 TYPES OF CARBON CREDITS
- Certified Reduction Unit (CDM)
- ERU (JI)
- Removable Units based on Carbon Sinks

EVALUATION OF CARBON TRADING
- Better predictor of emission pathways persuaded by a country
- Instrumental in introducing environmental planning in corporate sector
- Provided flexibilities to the participating countries in reducing their emissions thereby helping in survival of Kyoto Protocol.

THE CRITICISMS ARE
- Market price of Carbon Credit can't be determined b/c it depends on demand - supply.
- Responsible for Carbon leakage i.e., emission saved @ one place but emitted somewhere else
- It is mechanical exercise and does not take into consideration the socio economic cost of climate change

CLEAN COAL TECHNOLOGY

→ Use of coal is responsible for following issues :-

- Release of CO_2 is the reason behind global warming
- SO_2 and NO_x are responsible for acid rain.
- Particulate matter and low efficiency of thermal power plants.

⇒ CCT IS RANGE OF SOLUTION TO ADDRESS THE DIFFERENT TYPES OF ISSUES EMERGED OUT FROM THE USE OF COAL

CARBON SEQUESTRATION — To address issue of CO_2

→ Removal, capture or sequestration of CO_2 from Atmosphere to slow or reverse atmospheric CO_2 pollutions and to mitigate or reverse climate change.

→ It can be Natural as well as artificial.

→ **Natural Sequestration** → Zero tillage, Carbon sinks, **Carbon fertilization** [CO_2 ↑ → Photosynthesis ↑]

→ Some Experiments have been performed :-

- Iron Fertilization and Urea Fertilization where population of the phytoplankton was increased by adding iron and Urea.
- Consequently population of phytoplankton was increased which resulted in higher photosynthesis to remove CO_2.
- Their was still a limitation here as well.

- **Permaculture** → "Permanent Agriculture" → creating self sustaining ecological units.

→ **Artificial Sequestration** →

- Carbon Capture Storage → CO_2 is captured by Liquid Ammonia solutions in cylinders, once these cylinders are saturated, then the steam is passed through them, which causes the release of captured CO_2 which is either stored in Earth crust or in ocean water. But both these approaches have ecological concerns
  - If CO_2 is stored in Earth Crust, gets released accidentally then it might resulted in suffocation deaths.
  - Storage of CO_2 in Ocean water will result in ocean acidification

∴ Carbon Capture Utilisation Storage (CCUS) is suggested where CO_2 is used in multiple ways rather than storage like production of **algal fuel**, **enhanced oil recovery**, **synthesis of plastics**, storage in saline aquifers, pumping in the coal beds (carbon gets adsorbed, methane is produced), transportation through pipelines.

- Algal fuel → Jamnagar refinery of Reliance → use captured CO_2 to grow Algae → oil is extracted → Biofuel.
- Enhanced oil Recovery → CO_2 → pumped in oil well → oil ↑
- Coal Bed Methane → Pump CO_2 in Carbon Rock cracks.

✱ IMPROVING EFFICIENCY OF THERMAL POWER PLANTS

→ Energy is No. 1 reason behind emission of CO_2 and Thermal PP's topmost emitter.

→ Global Average of TPP → 39%.

→ India ← Old TPP → 29.5%.
  ← new TPP → 36%.

→ If the ~~emission~~ efficiency of plant is increased by 1%. then emission reduced by 2-3%. If we touch it 50%. then.

→ To Improve Efficiency of TPP, we're working on 3 new technologies.

→ **Integrated Gasification Combined cycle (IGCC)**

- Steam is passed over coal to convert it into the Syn Gas ($CO + H_2$) then nascent oxygen is passed through the mixture which forms CO_2 and H_2 (remove impurities) → mixture used to rotate gas turbine,
- After rotating turbine there is some residual heat which is used to convert liquid water into steam to rotate second turbine.

$$COAL \xrightarrow{steam} \underbrace{CO + H_2}_{\text{syngas}} \xrightarrow{[O]} \underbrace{CO_2 + H_2}_{\text{Remove Impurities}} \rightarrow \text{Rotating gas Turbine}$$

$$CO_2 + H_2 \rightarrow \text{Residual heat} \rightarrow \text{Liquid water} \rightarrow \text{steam} \rightarrow \text{Turbine II Rotated.}$$

[Other Benefits]

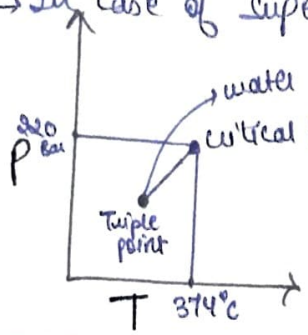
1. It can be linked with Carbon Capture storage to bring down emission to almost 0.
2. Less water consumption
3. Particulate matter will come down by 99%.
4. Hydrogen is extracted, which is not possible with the conventional use of the coal.

- India's first IGCC plant by BHEL & APPCL near Vijayawada. It will produce 125 MW. some components will be imported.
  → Our Ash Content in our coal is 45%.
  ∴ Import 10-20% ash content coal.

→ **SUPER CRITICAL TEMPERATURE TECHNOLOGY (SCT)**
&
ADVANCED ULTRA SCT

→ Phase diagram to check behaviour of water under diff. temp. and pressure condition.

→ In case of Super Critical Tech.



→ water is in all three phases simultaneously.
→ Critical Point - water is neither liquid nor vapour → **supercritical fluid**
Used for rotating the turbine.
It is SCTT

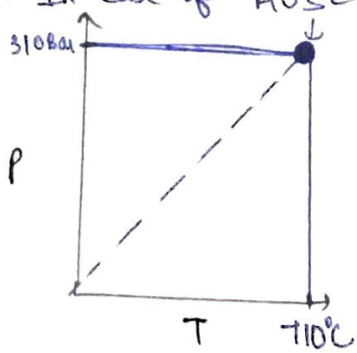
2006 (A) Planning Commission adopted Integrated Energy Policy.
" " recommended the use of SCT in Ultra Mega Power Plant (UMPP) → thermal power plant with capacity of or least 4000 MW.

- Plan was to have 12 such plants → only 4 have been allocated.
  1. Sasan in MP - Reliance
  2. Tilaiya in JH "
  3. Krishnapattanam in AP - Reliance
  4. Mundra in GJ - Tata
- Allocation is done by Power Finance Corporation (under Ministry of Power) on the Basis of Built Own and Operate (BOO).
- Govt → Power Purchase Agreement

(B) TPP ≥ 1500 MW → Retrofitted
(C) New Thermal PP of any capacity have to use SCT

→ In case of AUSCT - Temperature is 710°C and the pressure is 310 Bar.
- Joint Venture of BHEL, NTPC, ICAR
- Capacity 800 MW

[make equipment for SCT, AUSCT]



* **COAL BENEFICIATION**

→ For reducing particulate Matter.
→ the Ministry of Env. and Forest and Climate change has issued a notification that coal mining cap. will not supply coal with ash not more than 34%.

→ for this purpose, mined coal is put in a fluid of certain specific gravity, the non combustible part which is ~~effect~~ heavier settles down and lighter coal floats which is then collected and transported.

⇒ EVALUATION OF CCT

→ MERIT

① Cost of combating Climate Change will come down by half.
B/c we can't shut down TPP to decarbonise.
Economy will go down if complete shut down.

② It will address all types of pollution.

③ Breathing space to developing economy.

→ DEMERIT

① Technology Transfer → IPR with CCT is with developed economies.

② Massive investment

③ Pollutants will be captured then net efficiency will be reduced.

BIOFUELS

→ Derived from Biomass (plant Based / animal Based)

→ Brazil started Bio-Alcool Program → govt encouraged the farmers to go for sugarcane and sugarbead plantation → Extract Carbohydrate → produce the Ethyl Alcohol (Ethanol) → Blended with petrol → E-5, E10, E15.

→ Gradually this programme became popular.

→ Shift from food crop to fuel crop.

→ This change promoted Food & Agricultural organisation (FAO) to publish a report with theme " Food crop V. Fuel Crop"

→ Fuel crop > food crop → starvation, inflation

→ This lead to a debate which necessitated the search for producing biofuels through alternative methods.

⇒ THESE BIOFUELS ARE CLASSIFIED IN 4 GENERATION

I^st GENERATION → Crop → biomass → bio fuel.

→ Include biofuel from the direct planting of the crops, it includes. bioethanol, biodiesal etc.

→ Biodiesal → chemically an ester produced by chemical reaction b/w fatty acid and alcohol → Transesterification

→ Green Diesel → chemically similar to diesel produced through fractional distillation. Biodiesel has recently been used in AN 32 A/Cs of IAF. It was named Biojet fuel, produced from Jatropha curcas which is also known as green gold, the fuel was produced by chhattisgarh biodiesel development authority

→ Evaluation of Biodiesal
- No particulate matter
- No sulphur emission but there will be some nitrogen emission
- Under extreme cold conditions it started freezing.
- Carbon negative.

→ fuel V. food

→ Forests were cleared to make up for the loss of agriculture

* IInd GENERATION BIOFUEL

→ Based on agricultural waste.

→ Stuble burning cause air pollution in Delhi → It can be addressed.

→ Agricultural waste (complex carbohydrates) —treated→ Chemicals added to produce syn gas → Fuel

→ No diversion of agricultural land for food

→ No issue in food security

→ Agri-waste is produced in decentralised manner.

→ Need to have 2G Bio refinery in a distributed manner

→ 1st 2G Biorefinery is coming up at Bargarh in Odisha.

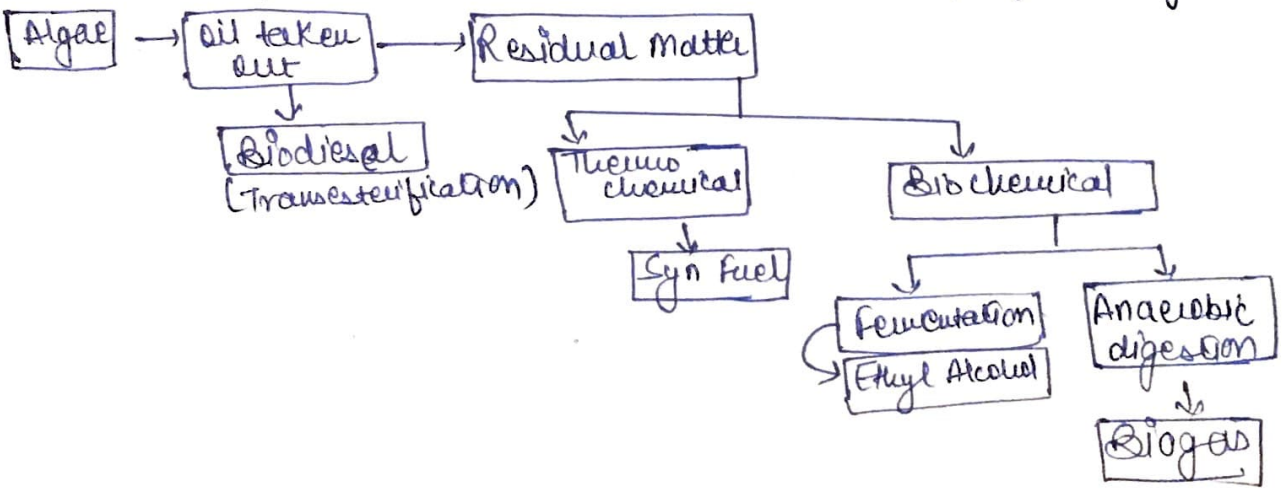
→ Transportation? → Possible

* III GENERATION BIOFUEL

→ Algal fuel is most promising among all, b/c algae grows in highly diverse conditions.

→ It grows fast

→ In some algae oil content is as much as 60% of the algae.



4th GENERATION BIOFUEL

→ Algae → genetically modified to increase oil content.
→ Other than this everything is similar to III Gen.

⇒ NATIONAL BIOFUEL POLICY

2008 → First NBP

2018 → Second NBP

→ Target of 20% Ethyl Alcohol Blending and 5% Biodiesel blending till 2030

→ Classified Bio fuels into two categories

① BASIC → 1G

② ADVANCED → 2G, 3G, Drop in fuel, MSW, Bio H_2, Bio-CNG

Rivers
Waste to Energy
Link
basis of Swachh Bharat Mission

Drop in Fuel → synthetic and completely interchangeable substitute for conventional petroleum-derived hydrocarbons.
→ Not require adaptation of the engine, fuel system or fuel distribution network.

• **MSW** →

→ Viability Gap funding for 2G Biorefinery plants and other advanced biofuels.
→ In order to increase production of Bio fuel now the rotten food will also be used as raw material.

⇒ ADVANTAGES

→ Ethanol production can help in improving can help in improving the rural economy.
→ Cut down import bill
→ Will help in achieving energy security
→ Reduce Pollution.

⇒ DISADVANTAGES

→ Too much consumption of water
→ Indirect land use i.e. → clearing forest.

• Gradually the biofuels have become capital and tech intensive. Therefore socio economic aspect has been missing

ENERGY EFFICIENCY

→ Two dimensions → Supply side → Oil & gas
→ Power sector
- IGCC
- SCT
- AUSCT

→ Demand side → UJALA scheme
→ Star labelling
→ Energy Conservation Building code/ GRIHA CODE
→ NMEEE
→ SMART GRID

⇒ NATIONAL MISSION ON ENHANCED ENERGY EFFICIENLY (NMEEE)

→ NMEE is part of National Climate Action Plan (NCAP)
→ To save Energy resources.
→ Import Bill will go down.
→ Implemented by Bureau of Energy Efficiency

e.g. Aluminium Plants

	A	B
	10 MW	8 MW
	x Tonne	x Tonne

BoEE told → produce x tonne of Al by using 8 MW

8 MW [A] used 7.5 MW [B] used 8.5 MW

↳ will issue Energy Saving Certificate → ESCerts

Bill less → A → ESCerts | B → has to buy ESCerts. → Bill more

- This is known as PAT scheme (Perform Achieve & Trade)
- Behavioural Change → Pollution is costlier.

⇒ SMART GRID → Amalgamation of technology.

→ It is use of range of technology and solution in all sectors of electricity.
i.e. Generation, Transmission, Distribution.

→ Distribution is the weakest ∴ power sector reforms in India should be

→ Dynamic pricing → Peak hours and Non Peak Hours to introduce differential pricing → Demand ↑, Tariff ↑

① → Advanced Metering Infrastructure → Net metering → National Solar mission.

→ IT → electric meter → bidirectional communication to convey real time information regarding peak hours and Non peak hours.

→ Reducing demand and supply gap.

→ Ecological footprints of the energy sector b/c if needs of people are met with same production → no extra energy.

→ Net Metering → To promote solar power

(2) → Super Conducting Cables → will bring down Aggregate technical and commercial losses (AT&C) → 23.5%.

→ Demand and supply gap → 11.5%.

(3) → Smartgrid will promote use of hybrid electric vehicles → improve plant load factor.

two concerns
- When to charge? → Non-Peak hours
- Lithium ion battery → cost ↑

(4) → Smartgrid will increase the share of Renewable energy in the overall energy mix

→ Deen Dayal Upadhyay Gram Jyoti Yojana
- Microgrid
- electricity in evening only

(5) _____ - ~~Evolve~~ Sam Pitroda → Brought IT into India

National Mission on Smartgrid

SOLAR POWER

- JNNSM
- SG
- NCEF
- SECI
- ISA
- REINVEST
- OSOWOG
- DCR
- Smart Grid
- Generations of solar cells.
- Solar Wind Hybrid + Green Hydrogen Mission
- floating solar plants

- 50% of electricity will come from Renewable resources by 2030 (500 GW)
- A big chunck will be from solar power (wind, biomass, Hydropower Project)

NON-NUCLEAR ENERGY

By :- SAURABH SINGH

Clean-Coal Technology :-

↳ Problems with the Use of Coal are :-

(a) Emmission of CO_2

(b) emission of NO_2 and SO_2, Particulate Matter (P.M.) and low efficiency of Thermal Power Plant.

* Clean-Coal-Technology is a range of solution to the address the removal of these Pollutants.
it includes :-

(a) * Carbon-Sequestration, means removal it can be Both natural as well as Artificial. This Process of Storing Carbon in a carbon Pool.

↳ The Natural Process of carbon-sequestration :-

(i) carbon Fertilization.
its a Natural Process when the Plants react to the increasing concentration of CO_2 by enhancing the intake but Beyond the certain level the leaves gets damaged.

(ii) Iron-Fertilisation
Also known as "Loha Fax", carried out in Arabian Sea in this experiment Iron as a Nutrient was added to increase the Population of the Phytoplanktons to absorb more CO_2.

(iii) Urea-Fertilisation.
It was Conducted in Sea near Phillipines to study the impact on atmospheric CO_2 by increasing Phytoplanktons Population by adding Urea.

(b) Zero Tillage :-
leaving the land fallow up to Promote the absorbption of more CO_2.

(c) Carbon Sink in the form of Trees

(d) Permaculture (Permanent agriculture).

↳ Artificial means of carbon-sequestriation :-

(a) Direct air Carbon Capture storage.

(b) "Bio-energy carbon Capture storage".
↳ it requires growing Plants and than using it to Produce energy, but CO_2 is not released in the atmosphere.

(c) "Carbon-Capture storage" (or) "Carbon-capture utilisation Storage".
↳ it involves the use of liquid ammonia to absorb CO_2 from Flue gas, once the cylinder is saturated with CO_2 it is transported to a storage site where steam is Passed to cause the release of CO_2 which is directed either in both of the Earth's Crust or in ocean water. in both of these cases there are Possible environment Fallouts like • increase in ocean acidification.
• accidental release of stored CO_2 causing suffocation death as happened in lake Nyos (in USA).

For Reducing Particulate Matters (P.M.), Coal Beneficiation is used. the Notification in this regard is issued by the MoEnvt. Forest & Climate change (MoEFCC), the Combustible Part is lighter in weight whereas Non-Combustible Part is responsible for Ash that is Heavier. When the Coal is Put in the Tank the heavier Pieces Settled at the Bottom Where as lighter one Flows, this is How Segregation is carried out.

⇒ Efficiency improvement

The established Benchmark is for every 1% increase in efficiency the emission decreases by 2 to 3%.
There are 3 major technology used & developed :-

(i) IGCC (Integrated gasification Combined cycle).

↳ In this Method, steam is Passed over coal to form syn gas through the mixture of, Nascent O_2 (O_2) is Passed to Convert carbon Monoxide (CO) to CO_2 after removing the impurities the gaseous mixture is used to Rotating the Turbine, even after that the residual Heat is left which is used to Produce steam to rotate another turbine to make it Combined cycle.

↳ The Benefits of IGCC are :-

- When Coupled with the Carbon Capture Storage there will be zero emission.
- it will Produce Blue Hydrogen.
- less Consumption of Water.
- No Particulate Matter.
- Almost 99% elimination of Sulphur dioxide and Nitrogen oxide (NO_x).
- efficiency is around 45%

↳ BHEL & Andhra Pradesh Power Generat" Coorporation are building IGCC Plant near Vijyawada.

(ii) Super Critical & Advance ultra Super Critical.
(SCT) (AUSCT)

↳ In 2006, Planning Commission introduced integrated energy Policy, and introduced "Ultra Mega Power Plant" (UMPP) with the capacity of 4000 M.W., the Plan is to allocate 12 UMPP, 4 of them are already allocated i.e,

- Krishnapatnam (A.P.) to Reliance
- Sasan (MP) to Reliance
- Telaiya (JH) to Reliance
- Mundra (MH) to Tata.

The Process is initiated by the Power finance Coorporation (PFC) by Setting up SPV (special Purpose vehicle) to get all the clearances and finally it is alloted on the Basis of B-O-O (Built-own-operate). They have to go for ~~P-O~~ "Power Purchase Agreement" to Supply the electricity to the govt. later, it was adopted to Retrofit those Thermal Plant with the capacity of 1500 M.W. (or) More with the "Super Critical Temp." (SCT) technique. after that the decision was that All the New Thermal Plant will have to use Super Critical Temperature.

In Super Critical Temp., Plants, the Water is heated to 374°C, and Pressure is of 220 bar to form Super Critical fluid which is used for Rotating the turbine. in Advance Ultra Super Critical (AUSC) Plant, the Temp. & Pressure will be 710°C & 310 Bar respectively.
one of the N.T.C Submitted by India is having a Provision that it will develop the technology and will share with ~~all~~ developing & least developed Country.
The AUSC Plant will have a Capacity of 800 MW. it is jointly Research by "Indira Gandhi Centre for Atomic Research", BHEL and NTPC.

⇒ Critical Evaluation of Clean-Coal Technology :-

(i) it will reduce almost all types of Pollutants, the use of Carbon-Capture storage will reduce emission to zero (0).
(ii) if De-Carbonisation of Energy Sector is carried out than the investment will require and it will be twice as Compared to investment required for clean-Coal technology. in short, cost of Combating Climate change will be reduced to Half.
(iii) it will help developing & least developed Country in Smooth Energy Transition.

→ The challenges are :-

- It requires Massive investment for Pipeline & other infrastrucal investment.
- The capture & Transportation of CO_2 will also compromise with the efficiency.
- The developed economies are extremely reluctant to share the Technology. They are using the weak IPR regime as an excuse for denying the technology.

Bio-Fuel

↳ They are derieved from Bio-Mass which could be from Plant or Animal.
The eg. are Bio-diesel, Green-diesel, Bio-Hydrogen, Bio-CNG, Methanol, Ethanol, Propanol, drop-in-Fuel, etc.

↳ In 1990s Brazilian govt. adopted "Pro-Alcool" Program to Promote Sugar Cane & Sugarbeat cultivation for ethanol Production, to be blended with Petrol. later this Program was adopted by other countries as well.

Consequentially there was a shift in Agri-cultural Pattern, ~~This~~ change alarmed by this development. The FAO (Food & Agricultural Organisation) released a Report with theme "Fuel Crop v/s Food Crop", the report stressed that the change in Agriculture Pattern will have negative consequenses with Food Security along with impact on agricultural ~~Pattern~~ diversity. This result initiated to an alternative research which lead to classification of Bio-Fuel into 4 Generation :-

24/02/22

1 1st Generation :-

(a) Ethanol Blending Program.

In 2001, Pilot Project on 5% e.b. was started. In 2003, it was extended to the whole Country. ~~In 200~~

In 2008, the first National Biofuel Policy was adopted with the target of 20% blending by ethanol by 2017.

As Per 2018, National Biofuel Policy, 20% e.blending & 5% diesel blending was to be acheived by 2030, but Now the ethanol target has been shifted to 2025.

In 2022, 10% Blended ethanol Petrol will be available in the Market. The vehicles will came into 2023.

The Min. of Road, Transport and Highway has announced Flax Fuel vehicle Policy, which can operate from 20% to 100% ethanol. TVS Apache bike will also run on ethanol blended Petrol.

↳ Reasons for ethanol Blending are :-

- it will save around $400 Billion, and that money will Circulate in Rural Economy thereby addressing the Poverty.
- It will have relatively less Green House emission.
- It will contribute the Self Sufficiency Measures by reducing oil imports.
- There will be an impact on Pollutants like CO, Hydro-carbon and NO_x to some extent.

↳ challenges in ethanol Blending :-

- The Current ethanol Production is Primarily based on SugarCane Production. if ~~Production~~ target of e-blending is achieved by this ~~Product~~ route than 10% of agricultural land will need to be diverted, and it might have Repurcussion on food Security.
- The Water Footprint of ethanol Producing Crop is another Concern.
- The vehicles have to undergo Technological Modificat?, the automobile industry has already received two shocks, when they moved From BHARAT Stage-4 to BHARAT Stage-6 and than the impact of Covid and therefore there is a Serious ~~dought~~ doubt that whether they will Mobilise their Resources for this type of Modification.
- Ethanol ~~Blending~~ Pricing is not done through a Mechanism ethanol is a inflammable Substance. and therefore its transportation will be risky.

* BHARAT-Stage (BS) emission standards are laid down by G.O.I. to regulate the output of air Pollutants from internal combustion engine & Spark ignition engine equipment including Motor Vehicles.

B-S-1 → 2000	BS III - 2010	BS-VI - 2020. ↓ said that NO_x emission will be brought down by 68% in diesel & 25% in Petrol Cars.
BS II → 2005	BS IV - 2017	

↳ Way Forward :-

- Use of Water Sparing Crops like Maize.
- Explore the Possibility of 2G-Bio Refinery.
- Have a Transparent Process for deciding ethanol Pricing.
- Create a Technological upgradation Fund for the Automobile Manufacturing industry to Manage the Transition.

→ In The 1st stage, of The fuel crops are grown like Jatropha, Pongamia pinnata, Madhuca indica (महुआ), etc.

→ Ethanol is done through Fermentation, where as Bio-diesel is chemically Ester Produce From Edible and Non-edible oil through the Process of Trans-esterification but its efficiency is Comparatively lower, it Freezes in extremely cold temperature, there is increased Production in Carbonyl Pollutants, there is some emission of NO_2 as well.

Green-diesel is also a Biofuel, chemically it is Similar to diesel, Produced through Fractional distillation.

[2] 2nd-Generation Bio-Fuel :-

They are based on Agricultural Wastage. Deptt. of Biotechnology and US dept. of Energy has collaborated on 2-G Bio-Refinery and the first one has to come up at Bargarh (odisha).

Recently, an initiative has taken of Making "Biofuel-Pallets" from the Stubble to be mixed with the other fuels. it will help in reducing the Problem of Stubble burning to improve air quality.

The agricultural Waste, Which is a Complex Carbohydrate is treated under High temp. with Some Chemical to form Syn gas, Which is than ~~Converted~~ Converted into Fuel.

The challenges here is the de-centralized Production of stubble. Financially it will not be Possible to establish 2-G Bio-Refinery every where therefore through the MGNREGA, Panchayat should be made the collection Point of Waste & later Supply it to the Refinery.

3. 3rd-Generation Bio-Fuel :-

It is Algal Fuel, which is the most Promising among all. if 2% of Earth's ~~as~~ geographical area can be used for Algae Production than the all energy needs can be fulfilled.

↳ Advantages of using Algae are :-

- it grows fast.
- it ~~for~~ grows in diverse condition.
- in some species oil content is even upto 60%

From Algae oil is extracted & than converted into Bio-diesel. The residual matter is converted into different fuel depending upon whether Method used is Bio-chemical Method (or) Thermo-chemical approach is used.

4. 4th Generation Bio-Fuel :-

In this Algae is genetically Modified to increase its oil content, Rest is Same as that of 3rd Generation.

The National Bio-Fuel Policy, 2018 has classified Bio-Fuel into :-

(i) Basics, includes 1-G, Bio-ethanol and Bio-Diesel.
(ii) Advanced, includes 2-G, 3-G, Bio-CNG, Bio-Hydrogen, drop-in-Fuel.

This Policy has also created Viability gap Funding to Support the advanced Bio-Fuel. it has Broaden the difination of Raw Material for Bio-fuel Production.

ENERGY - EFFICIENCY

↳ It has Two dimensions :-
(i) Supply Side (ii) Demand Side

↳ Supply Side includes Thermal Power (IGCC, SCT, AUSCT) and oil gas.

oil gas has Flaring and Venting Process. responsible for Green House gas emission. Venting is controlled Release, and Flaring is controlled burning.

World Bank has started "Global Flaring and Venting Reduction Program".

↳ Demand Side efficiency includes UJALA, Star labelling of electric appliances, Green Building Code, GRIHA Code, Energy Conservation Building Code.

⇒ The other Measures for Energy Efficiency :-

NMEEE

↳ National Mission on Enhance Energy Efficiency

↳ It was one of the Mission under Nation Climate Action Plan. in its 1st Phase Star labelling of the electrical appliances and almost half of the target of emission intensity is Achieved. The commitment Regarding emission intensity reduction was made in 2009 that by 2020 → 25% reduction will be carried out with 2005 as the base year.

In 2015, it was increased to 35%, now it is 45% reduction has to be carried till 2030. it operates on PAT Scheme (Perform-Achieve-Trade) introduced by BEE (Bureau of Energy Efficiency) for the Sectors like Fertilizer, Chlor Alkali, thermal Power, Cement, Steel, Textile. if a Particular Manufacturing unit Performs better than a target than they ~~release~~ Recieve Energy Saving Certificate which have to be Purchased by those who have Failed to Achieve the targets.

SMART- GRID

It is the Range of Technology & Solution in all the Sectors associated with the Power generation (i.e, Transmission, Generation & Distribution).
The Primary Focus is distribution Sector which is the weakest among them.

↳ The Attributes/Advantages of Smart Grid are :-

- Advance Metering Infrastructure.
  it is using Electric Meter with Artificial Intelligence to establish two way communication between despatch Point & Consumption Point.
  it will help in introducing differential Pricing that means Peak & non-Peak hour that will reduce the wastage. thereby Bridging the gap between the demand & Supply and bringing down the ecological Footprint of the Energy Sector.
- The use of Super-Conducting cables will minimise the technological losses. at the Present, Aggregate Technical and Commercial losses are around 22.5%, the acceptable ranges between 10%.
- it will Promote the use of electrical vehicle as they can be charged during Non-Peak hours that will improve the Plant load Factor as well.
- Smart grid will increase the Share of Renewable energy in the overall energy Mixture.
  For eg. Under D.D.U.G.J.Y. (Deen Dayal Upadhyay Gram Jyoti Yojna), Micro grids are Promoted for Rural electrification. more than 90% of them are based on Solar.
  The Smart grid will also be the launch Pad for the Regional Grid Connecting India with Bangladesh, Bhutan, Myanmar & Nepal Paving the Way For "One-Sun-one-World-one-Grid".

25/02/22

SOLAR-POWER

Jawahar lal Nehru National Solar Mission, it ~~was~~ was announced in 2008, and started in 2010.
In 2010 itself a cess was imposed @ ₹50 on every Tonne of Coal Mine which was Transfer into National clean Energy Fund.

In 2011, Solar Energy Coorporation of India was Created to execute the Solar Power Projects. The 1st Phase of "National Solar Power Projects". The 1st Phase of National Solar Mission was from 2010 to 2013. 2nd Phase from 2013 to 2017, in this Phase domestic Content requirement was introduced that is in order to receive Financial Support from the Govt. the Solar Power Producers have to buy the certain Percentage of Panels from Domestic Manufacturers. Another condition was that the govt. is the Buyer. it was challenged by USA in WTO which awarded the decision against India. This decision is a Mixed Bag, good from the Point of Solar Power Program speed but it dealt a Bodyblow (~~error~~) to domestic Panel Manufacturer.

The 3rd Phase (2017 to 2022) target is to Produce 1 lakh M.Wt. by 2022 and Possibly 3 lakh M.Wt. by 2030. of 1 lakh M.Wt. target 40% will be through roof top Panels which are ~~Join~~ Promoted "Net Metering", Subsidy and SARAL index. 40% is ~~#~~ in the form of ultra Mega Solar Power Projects these are Solar Points with the Capacity of More than 500 Wt., Remaining 20% Can be Produced from Miscallaneous options.

To Support the Transmission through Solar Power to Solar grid. Ministry of New & Renewable Energy (MNRE) has come with "Green Energy Corridor".

In the first stage, it is to be completed by 2022, 24 G.Wt. will be transmitted. in the Second Phase 20 G.Wt. of Renewable Energy will be Fed to Power grid.

Green Energy Corridor has been supported by Germany, USA through ~~PACE~~ PEACE Program (Promoting Energy Access through Clean Energy). it is about the Consolidation, and Standardisation of Renewable energy before being Feb into Power grid. The Frequency Benchmark is 49.5 Hz to 50.05 Hz.

Under Green Energy Corridor, the Renewable Energy will be evacuated and Consolidated. ~~They~~ Thereby decreasing the dependence on local Consumption.

*[connect with Smart grid.]

International Solar Alliance [I.S.A.] :-

At the 21st C.O.P at Paris Indian P.M. & French President Francois Hollande, announced the setting up of I.S.A. to focus on 121 Sunshine Country receiving Sunlight for more than 300 days. The condition regarding ~~the~~ its enforcement was it must be Signed & Ratified by atleast 15 Countries. It is the first International body with its Head Quarter at Gurugram (India). The Target is to generate 1 Terra Wt. of Solar Power and Mobilise $1 trillion by 2030. it is going to acheive this target by 5 Pathways :-

(i) Mobilise the Funds.
(ii) Promote Solar Power in Agriculture.
(iii) Micro Grids
(iv) Rooftop Panel
(v) Solar Powered Vehicles.

↳ I.S.A. is an enabler & Facilitator. its role is to:-

- Popularize Solar Power, reduce the cost of Production,
- Promote Research & development.
- enhance the skills of the People.
- Create a risk Mitigation Mechanism, it will carry out the Commercial Fissibility studies for the Setting up of "One-Sun-One-World-One-Grid".

↳ I.S.A. is an excellent opportunity for India to Present an alternative Model of development in the Context of Climate Change, and to Project itself as a leader in the absence of USA from Paris Agreement.

One-Sun-One-World-One-Grid :-

↳ At 2018, I.S.A. Summit a Proposal in this regard was made, at the 2021 Glassgow Climate Summit it has been given a final shape by Indian P.M. & UK P.M. Borish Johnson. it will be a trans-National grid to Supply the Solar Power from the Countries receiving Sun light to those having Sun set. it will resolve the challenge of high storage Cost, which is a dettering effect / Factor.

↳ For Identifying the Solar Power Potential of a Place, ISRO will develop a Solar Calculer using 3 Earth observation Sattellite (E.O.S.) that is :-

(i) Kalpana-1
(ii) INSAT-3D
(iii) INSAT-3DR

↳ To start it, India will establish a Regional grid linking Bangladesh, Bhutan, Myanmar & Nepal. The first Phase will Connect South-Asia with S-E-Asia & W-Asia.
The 2nd Phase → Africa will be Connected, and
in 3rd ,, → Globally it will Linked by 2050.

For Funding, Rock Fellar Foundation, Bezzo's Fund and other Multi-lateral Bank have created GEAPP (Global Energy Alliance for People & Planet). It will have a Corpus of $ 100 Billion for Asia, Africa and latin America.

→ It will help India to counter Chinese energy diplo-macy. To enhance its Soft Power Influence.

*[link with Smart Grid & Green Energy Corridor].

Waste to Energy

→ It is one of the flagship Program of G.O.I.. its objective is to utilise Municipal Solid Waste to Produce around 1500 Mt. Energy. A/C to Projection, by 2050 around 70% of the Population will be in Urban Area. Thereby, the Waste generated will be more. and the Waste collected at land fills sides causes Air, Water and Soil Pollution.

Under Swachh Bharat Abhiyan, 6 Waste to Energy Plants are Planned for Delhi-NCR. with the Combined Capacity of 74 M.Wt. as the Production is less therefore they are based on Public-Private Partnership. Waste to Energy is also Critical for the Success of River Cleaning Program and Promoting health. That's Why Swachh Bharat Abhiyan is Based on Waste to Energy Concept. The Municipal Solid Waste Room has Mandated that at least 5% of the fuel should be R.D.F. (Refuse-derived-Fuel).

The Green Waste re-processor Startups is using Bio-degradable Waste to Produce R.D.F.. Recently, Biofuel Pallets Concept is introduced for utilizing the Crop Stubble.

↳ The National Power Tarrif Policy has also mandated the use of Waste generated from the Sewage treatment Plant by the Thermal Plants.

↳ The Waste to Energy Plants have been awarded Carbon-Credits. Eg. Okhla-Timarpur (Delhi NCR).

↳ Concerns :-

- Most of these Plants are based on incineration (Burning) which definately causes Air Pollution.
- Segregation and Transportation of the ~~Plants~~ Waste is also difficult.
- The caloriphic value of the Waste is low.

↳ Techniques of obtaining Energy from Waste :-

(i) Incineration
↳ it involves burning of Waste Material.

(ii) Gasification
↳ it involves heating of the organic waste in the absence or Partial Presence of air to form Mixture of air that is used for Rotating Turbine. The Sugar Plants are using Bagasse (residue left after extraction of juice) gasification to help in acheiving 10,000 M. Wt. from Bio mass which is a Part of India's first N.D.C

(iii) Electro-Chemical
↳ it is about the use of Microbial Fuel Cell, in this arrangement the Anode carries the organic waste, and conditions are Anaerobic. the Bacteria degrades the waste matter to generate the Hydrogen ion (H^+) & electron (e^-). Both of them moves to Cathode where H^+ reacts with the oxygen ion to form H_2O and Produce Electricity. The Microbial Fuel Cell Cannot Work in extreme low (or) High temp. Conditions. and The pH should be Neutral (7).

(iv) Bio-chemical :-

↳ it includes Biogas & Ethanol Production.

(v) Poly-Crack Technology

↳ Indian Railway at Mancheshwar (near Bhubaneswar) has estb. this Plant.

↳ it uses all types of wastes including Plastic, Petroleum Slug, Municipal Solid Waste, etc. to Produce gas and the Fuel.

↳ it does not require the segregation of wastes.

↳ The Moisture can be as high as 50%. Moreover it is a zero-discharge Technology.

Green Hydrogen

~~Green Hydrogen~~

↳ There is a color Coding of the Hydrogen a/c to the Source.

i.e, • Brown Hydrogen → From Coal.

• Blue " → From Natural gas, But when Carbon-Capture & storage is also used.

• Grey " → Natural gas (No use of Carbon-Capture & Storage Here.)

* Green " → Produce from Splitting of Water Molecules using Solar & Wind Power.

and, Blue, Grey & Brown Hydrogen are Produced from Coal gasification, Methane Steam Reforming.

↳ In 2003, National Hydrogen Energy Road was adopted with Two Program :-

(a) Green initiative for Future Transportation.

(b) Green " " Power.

↳ In 2021, National Green Hydrogen Mission was announced to make India an exporter of Green Hydrogen to Produce 5 Million tonne by 2030, and acheive Energy independence by 2047.

↳ Green Hydrogen is a Sunrise Sector to deal with climate change and help Countries in acheiving the Paris targets. it is a new green Hope. It will focus on "Hard to abate industries" like Refineries, Fertilizers & Steam.

- For Refineries the targets of utilizing Green House are like 10% for 2023, and by 2028 it will be 25%.
- For Fertilizer it is 5% by 2023, and 20% by 2028.

↳ Green Hydrogen will help in Fulfilling the Climate change Commitment made at Glassgow that there will be one Billion tonne extra emission reduction Compare to Business as usual.

↳ The challenges :-

(i) = The duck-curve Phenomena is a Problem associated with all Renewable energy like Solar, Wind, Hydrogen.

(i.e, When More generation → demand less & When demand more → generation less)

So, All the Renewable Requires Massive Storage investment and to create Trans-National Grids.

(ii) Cost.
i.e, at Present for Producing 1 Kg Green Hydrogen the expenditure is ₹340 to ₹400.
it has to come down to ₹150 for that the Cost of Production of Solar & Wind Power has to decrease further.

(iii) Hydrogen is ~~further~~ Highly inflamable So, its Trans-portation is Risky. and also its Mass to volume Ratio is very Poor which further increases the storage Space.

(iv) To Produce 1 Kg Green Hydrogen around 9 litre of water is required. Therefore long term solution is de-salination of water.
*[Link with Compact High Temp. Reactor].

(v) The Cost of Electroliser is also Prohibited.

National Green-Hydrogen Policy :-

↳ Provisions of National G-H- Policy :-

(a) it has waived Inter-State Transmission charges.
(b) The Fertilizer Plants are encouraged to Manufactore Ammonia using Green-Hydrogen.
(c) Single Window clearance for Green Hydrogen Projects.
(d) Power storage ~~capacity~~ Facility for 30 days for extra renewable.
(e) Renewable Purchase obligations, means defining a roadmap to consume Hydrogen Produced from renewable energy.

↳ Green-Hydrogen is ~~Most~~ not a solution in itself, it can only compliment the other climate combat initiative. As the climate change goal Post has shifted from emission reduction to Net Zero target around 14 Countries have legislated Net zero target and ~~so~~ 50 Countries are in the Process of doing so.

SHALE GAS :-

↳ Shale is a Hard, Non-Porous rock which has trapped Methane, extracted by method of Hydraulic fracturing (or) Fracking which requires Pumping a mixture of Water, Sand and Guar gum at High Pressure.

↳ one of the envt. Concern in the shale gas exploration is Contamination of ground Water and Consumption of Surface Water.

↳ In 6 Basins, total 117 Blocks have been identified as of now.

(i) Cambay Basin (GJ) → "Jambusar".
(ii) Gondwana Basin
(iii) ~~Kaveri~~ Krishna-Godavari Basin (Andhra Pradesh)
(iv) Cauveri Basin
(v) Indo-Gangetic Basin
(vi) Assam-Arakan Basin

Coal Bed Methane (CBM) :-

↳ It is Methane which is adsorbed on the surface of Coal Rocks due to Pressure of Water and mass of the Coal.

↳ To extract it de-watering is used.

↳ The Problem is Production declines very fast. in order to sustain it large no. of wells have to be drilled which brings the Problem of the land Acquisition.

Gas Hydrate :-

↳ also K/a "Fire-ice", Methane-Hydrate, Methane clathrate

↳ it is the densest Source of Methane on the Planet. found in Permafrost region & Continental Shelves. The methane molecules are trapped by water Molecul-es under conditions of High Pressure & low Temp.

↳ it is considered as Most delicately balanced System if it disturbed entire methane will be released in the atmosphere. as of now, No commercial Production of gas hydrate is done anywhere in the World.

HELP [Hydrocarbon Exploration Licencing Policy] :-

↳ Provisions :-

(i) Unified licencing Regime, means under one licence all Hydro Carbon can be explored from a given block.

(ii) Revenue Sharing.

(iii) open-acreage licencing Policy to Reduce import dependence by increasing domestic Production.