



## HYPERLOOP 2019

### Energy

CONSOLIDATED CURRENT AFFAIRS FOR ESE 2019

Contents

|  |    |
|--|----|
| 1. GEOPOLITICS AND ENERGY .....                                  | 6  |
| <b>1.1 Geopolitics</b> .....                                     | 6  |
| 1.1.1 Crude Supply .....   | 6  |
| 1.1.2 TAPI pipeline .....  | 6  |
| <b>1.2 Energy Trade</b> .....                                    | 6  |
| 1.2.1 LNG Imports .....  | 6  |
| 1.2.2 India to launch natural gas trading hub .....              | 7  |
| 1.2.3 Oil Buyers Club .....                                      | 7  |
| 2. RENEWABLE ENERGY .....  | 7  |
| <b>2.1 India's Renewable Energy Status</b> .....                 | 7  |
| 2.1.1 Targets .....  | 7  |
| 2.1.2 National leader in renewable energy generation .....       | 8  |
| 2.1.3 The Draft National Energy Policy .....                     | 8  |
| 2.1.4 India ranks 78th on WEF Energy Transition Index .....      | 8  |
| <b>2.2 Solar Energy</b> .....                                    | 9  |
| 2.2.1 Kochi airport won UN's champion of earth prize -2018 ..... | 9  |
| 2.2.2 World's largest solar park .....                           | 9  |
| 2.2.3 India's First in Solar Projects .....                      | 9  |
| 2.2.4 Rooftop Solar .....  | 10 |
| 2.2.5 KUSUM Scheme - solar power for rural India .....           | 10 |
| 2.2.6 Trina Solar launches TrinaPro smart PV solution .....      | 10 |
| 2.2.7 International Solar Alliance .....                         | 11 |
| <b>2.3 Biofuels</b> .....  | 11 |
| 2.3.1 National Policy on Biofuels - 2018 .....                   | 11 |
| 2.3.2 Plant microbial fuel cells (PMFC) .....                    | 12 |
| 2.3.3 Microbes help in making hydrocarbons .....                 | 12 |
| 2.3.4 Artificial leaf that creates biofuel .....                 | 13 |
| 2.3.5 India's first 2G biofuel plant .....                       | 13 |
| 2.3.6 Policy on biofuel for aviation sector .....                | 14 |
| 2.3.7 SATAT initiative .....                                     | 14 |
| 2.3.8 Biodiesel from used cooking oil .....                      | 14 |

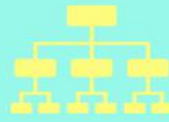
|  |    |
|--|----|
| 2.4 Wind Energy .....  | 15 |
| 2.4.1 Largest Wind Mill .....                                    | 15 |
| 2.4.2 Environmental impact of wind energy .....                  | 15 |
| 2.4.3 National Wind-solar Hybrid Policy.....                     | 15 |
| 2.5 Alternate Fuels .....  | 16 |
| 2.5.1 Germany rolls out world’s first hydrogen train.....        | 16 |
| 2.5.2 China’s Artificial moon Project .....                      | 16 |
| 2.5.3 Coal Based Methanol As Alternative Fuel .....              | 17 |
| 3. ENERGY CONSERVATION.....                                      | 17 |
| 3.1 Energy Efficient Buildings.....                              | 17 |
| 3.1.1 Energy-positive campus .....                               | 17 |
| 3.1.2 LEED Gold Certification: .....                             | 17 |
| 3.2 Energy Efficiency .....                                      | 18 |
| 3.2.1 India Energy Efficiency Scale-Up Program.....              | 18 |
| 3.2.2 State energy efficiency preparedness index .....           | 18 |
| 3.2.3 India’s first filament bulb-free village panchayat.....    | 19 |
| 3.2.4 3D conic device to increase solar-thermal conversion ..... | 19 |
| 3.2.5 The Chiller Star Labeling program .....                    | 19 |
| 3.3 Clean Fuels.....   | 20 |
| 3.3.1 A clean cooking strategy .....                             | 20 |
| 3.3.2 Pradhan Mantri Ujjwala Yojana.....                         | 20 |
| 3.4 Energy Storage.....  | 21 |
| 3.4.1 National Energy Storage Mission.....                       | 21 |
| 3.4.2 Lithium Ion Battery project.....                           | 21 |
| 3.5 Transportation.....  | 22 |
| 3.5.1 Delhi becomes first city to roll-out Euro VI fuel.....     | 22 |
| 3.5.2 Charging points for EVs every 3 km .....                   | 22 |
| 3.5.3 MOVE: Global Mobility Summit.....                          | 22 |
| 4. FOSSIL FUELS .....  | 23 |
| 4.1 Infrastructure .....   | 23 |
| 4.1.1 India’s emergency oil reserve .....                        | 23 |
| 4.1.2 Online portal for pipelines .....                          | 24 |

|  |           |
|--|-----------|
| 4.1.3 World’s largest greenfield oil refinery.....                     | 24        |
| <b>4.2 Exploration .....</b>   | <b>24</b> |
| 4.2.1 Exploration and Exploitation of Unconventional Hydrocarbons..... | 24        |
| 4.2.2 Discovered Small Field Policy.....                               | 25        |
| 4.2.3 Enhanced Recovery Methods for Oil and Gas.....                   | 25        |
| 4.2.4 Policy framework for Production Sharing Contracts.....           | 26        |
| 4.2.5 Coal auction reforms.....  | 26        |
| 4.2.6 Methanol Fuel .....  | 26        |
| <b>5. NUCLEAR ENERGY .....</b>   | <b>27</b> |
| 5.1 Nuclear Fusion.....  | 27        |
| 5.1.1 Fusion Energy Conference (FEC 2018) .....                        | 27        |
| 5.2 Nuclear Plants.....  | 27        |
| 5.2.1 Kudankulam power plant waste disposal .....                      | 27        |
| 5.2.2 Russia to set up more nuclear reactors in India.....             | 28        |
| 5.2.3 Exploitation of Atomic Minerals.....                             | 28        |
| 5.2.4 Floating nuclear power plant (FNPP).....                         | 29        |
| <b>6. TRANSMISSION AND DISTRIBUTION.....</b>                           | <b>29</b> |
| 6.0.1 PRAAPTI App and Web.....   | 29        |
| 6.0.2 Power grid Digitalisation.....                                   | 29        |
| 6.0.3 Smart electricity meters.....                                    | 30        |
| 6.0.4 Saubhagya scheme.....  | 30        |

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## 1. GEOPOLITICS AND ENERGY

### 1.1 Geopolitics

#### 1.1.1 Crude Supply

- India was asked by the U.S. administration to drastically cut down crude supply from Iran.
- U.S. withdrawn from the Iran nuclear deal and imposes fresh sanctions on Iran's economy, especially on its oil industry.

#### Options

- India can replace Iranian crude with supplies from Saudi Arabia, Russia, and the United States
- Iran may end special privileges to India, including rupee-denominated imports

#### Iran becomes India's No. 2 oil supplier

- It replaced Saudi Arabia
- India, Iran's top oil client after China

#### 1.1.2 TAPI pipeline

India has sought re-negotiation of the natural gas price it is to source through a proposed Turkmenistan-Afghanistan-Pakistan-India (TAPI) pipeline.

#### Highlights:

- The four nations to the pipeline projects had in 2013 signed a gas sale purchase agreement
- The project has not moved forward because of unresolved issues like the economic viability of the project, security of supply and tie-up of debt and equity.
- State gas utility GAIL India Ltd represents India on the consortium.
- The gas will be sourced from the Yoloten Usman field, which ranks amongst the five biggest fields in the world

### 1.2 Energy Trade

#### 1.2.1 LNG Imports

- India has begun importing liquefied natural gas (LNG) from Russia as part of its strategy to diversify its supply sources and cater to the rapidly rising local energy needs.
- Russia is the latest country to begin supplying long-term LNG to India after US, Australia and Qatar.
- India imports 45% of the total amount of natural gas it consumes.
- With the government's plan to raise the share of natural gas in the country's energy mix to 15% by 2030, import of LNG is expected to rise.

## The Flow

**First LNG ship from Russia reaches Dahej import terminal**

**India** also has long-term LNG contracts with US, Australia and Qatar


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**In 2012**, GAIL signed 20-year pact with Gazprom for supply of 2.5 MT of LNG a year

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|--|--|
| <p><b>Duration of contract</b> was later extended by three years</p> | <p><b>GAIL</b> to also buy additional 2 MT of LNG from Gazprom</p> |
|--|--|

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**GAIL** also has contracts with US for 5.8 MT per year of LNG

- The government expects half of India to have access to piped gas for cooking and transport.

**About GAIL:**

- GAIL is India's biggest natural gas transportation and marketing company.
- It is expanding pipeline network to operate over 15,000 km by 2020.
- GAIL commands 75 per cent market share in gas transmission and has a gas trading share of over 50 per cent in India.

**1.2.2 India to launch natural gas trading hub**

- The government plans to launch a natural gas trading hub by October, creating an Indian gas benchmark.

**Objectives**

- In order to further boost the consumption of natural gas in the country
- Currently, the government fixes the price of the bulk of domestically produced natural gas.

**1.2.3 Oil Buyers Club**

- India discussed with China the possibility of forming an 'oil buyers club' that can negotiate better terms with sellers as well as getting more U.S. crude oil to Asia to cut dominance of the oil block.
- At present the Organization of the Petroleum Exporting Countries (OPEC) supplies about 60% of India's oil needs.

**2. RENEWABLE ENERGY****2.1 India's Renewable Energy Status****2.1.1 Targets**

- 175 GigaWatt (GW) of installed capacity from renewable energy sources by 2022, which 100 GW of solar and 60 GW of wind power capacity.
- The total renewable power installed capacity in the country stood at about 70 GW in financial year 2017-18 .
- It stands to meet its greenhouse-gas emission goal under the Paris climate agreement.

**Concerns:**

- India has missed several interim milestones.
- Technological and financial challenges remain: both wind and solar generation could be erratic, and India's electricity grid must be modernised to distribute such power efficiently.
- The wind and solar tariffs have hit such low levels that suppliers are working with wafer-thin margins.
- The homeowners need to be able to sell electricity back to the grid, which in turn needs a nationwide "net-metering" policy, only a few States have such policies.

**Achievements**

- Renewable power installed capacity has already reached over 70 GW.
- Over 40 GW renewable power capacity is under construction/tendered.

- Globally, India stands 4th in wind power 5th in renewable power and 6th in solar power installed capacity.
- Round the Clock renewables policy has been finalized.
- The International Solar Alliance (ISA) has become first international intergovernmental organization headquartered in India.

### 2.1.2 National leader in renewable energy generation

Karnataka is the new national leader in renewable energy generation

- It has overtaken Tamil Nadu that had long been India's top renewables market
- Karnataka has a total of 12.3 gigawatts (GW) of renewable capacity installed till March.
- Tamil Nadu still leads in wind energy capacity

### 2.1.3 The Draft National Energy Policy

The Draft National Energy Policy has rolled out by the NITI Aayog with the primary goal of doing planning related to energy in terms of its mandate and coordinating role.

Objectives:

- The policy aims to improve the energy security of the country by reducing the dependency on imports
- To generate at least 175 GW of energy from renewable sources by the year 2022.
- It proposes higher taxes on SUVs and also promotes the use of public transport like metro, CNG buses to improve the air quality.
- It also predicts the increase in power demand shooting up over four folds.
- It also promotes phasing out of IC engines in vehicles and use of eco-friendly electric engines.
- As per the aim of this policy each and every household in the country will be electrified by the year 2022 and also get access to clean cooking fuel
- The policy aims to reduce the overall dependency on fossil fuels as they are exhaustible.
- By increasing the production through renewable sources will also promote the sustainable development goals of the country.

### 2.1.4 India ranks 78th on WEF Energy Transition Index

India has been ranked at 78th, lower than its emerging market peers like Brazil and China, among 114 countries on the World Economic Forum's Energy Transition Index that was topped by Sweden.

Highlights:

- The report titled "Fostering Effective Energy Transition", ranks countries on how well they are able to balance energy security and access with environmental sustainability and affordability.
- According to the report India has taken "bold measures" to improve energy access, energy efficiency, and to improve the deployment of renewable sources of energy.
- However, energy transition in the country will require "large investments, and an enabling environment and robust regulatory frameworks to support the transition"
- On India, the report said, energy needs in the country are primarily met by fossil fuels with implications for environmental sustainability and increasing energy import costs.
- A considerable share of India's population still lacks access to electricity and clean cooking fuel, it noted.



**About World Economic Forum:**

- The World Economic Forum (WEF) is a Swiss nonprofit foundation, based in Cologny, Geneva, Switzerland.
- It is committed to improving the state of the world by engaging business, political, academic, and other leaders of society to shape global, regional, and industry agendas.

**2.2 Solar Energy****2.2.1 Kochi airport won UN's champion of earth prize -2018**

Cochin International Airport Limited (CIAL) has been selected for the champion of earth prize -2018, the highest environmental honour instituted by United Nations.

**Highlights:**

- CIAL is honoured for its successful implementation of solar energy project to power the Kochi airport
- The CIAL was chosen for 'action and inspiration' which recognises individuals or organizations that have taken bold environmental action, and, in doing so, inspired others to follow in their footsteps
- CIAL, the company which owns and operates country's first airport built under public private partnership mode became power neutral on August 18, 2015

**About UN earth award :**

UN established champion of earth award in 2005 to recognise outstanding environmental leaders from the public and private sectors, and from civil society.

**2.2.2 World's largest solar park**

Pavagada solar park in Tumkur dist., Karnataka

- The park is set to become the world's largest when it attains its full potential of 2,000 MW.

**2.2.3 India's First in Solar Projects****Solar energy efficient Union territory - Diu**

- showing an effective way to people to harness solar energy source.
- Diu has made rapid progress in solar power generation.
- Diu has become the first Union territory where more than 100% of the electricity need is being met by solar power.

**Solar-powered island - Diu**

- Diu, part of the Daman & Diu Union territory
- Along with solar, Diu is also exploring wind energy
- Energy from solar parks is supplemented by rooftop solar

**Smart City to run on 100% renewable energy - The Diu Smart City**

- The first city in India that runs on 100 per cent renewable energy during the daytime
- The city has developed a 9-MW solar park spread over 50 hectares rocky barren land
- Diu also offers its residents a subsidy of Rs 10, 000-50,000 for installing 1-5 -KW rooftop solar panels.

**Industrial solar microgrid - Vadodara manufacturing facility in Gujarat.**

- ABB announced it has commissioned India's first industrial solar microgrid
- Microgrids with integrated battery energy storage allow cutting down of planned and unplanned power outage.
- The microgrid's rooftop photovoltaic field and its battery-energy storage system will support the factory's productivity and enable green power supply.
- A sophisticated control and automation system serves as the brain of the microgrid which ensures maximizing renewable energy use.

**100% solar powered Primary Health Centers (PHC) - Surat**

- There are a total of 52 PHCs in the district and all of them are now powered by solar system.

**Solar powered railway station- Guwahati**

- India's first railway station run by solar power.

**First' civic body to generate solar energy - South Delhi Municipal Corporation****Solar bicycle track corridor - Mukarba Chowk to Wazirabad of Delhi**

- The dual-use project will provide shelter from rain as well as sunlight both to cyclists and pedestrians while generating a large amount of clean energy by reducing carbon dioxide emissions from coal-based power plants.

**2.2.4 Rooftop Solar**

- Rooftop solar is the fastest growing segment in renewable energy in India.

**SRISTI (Sustainable Rooftop Implementation for Solar Transfiguration of India)**

- a. The proposed scheme will incentivise the installation of roof top solar projects in India.
- b. It aims to achieve a national solar rooftop target of 40 GW by 2021-22.
- c. Under SRISTI, a central financial assistance will be provided only for installation of roof top solar plants in residential sectors.
- d. Once approved, the concept will act as a basis for phase – II of solar rooftop power program

**2.2.5 KUSUM Scheme - solar power for rural India****'Kisan Urja Suraksha evam Utthaan Mahabhiyan (KUSUM)**

- Installation of grid-connected solar power plants each of capacity up to 2 MW in the rural areas
- Installation of standalone off-grid solar water pumps to fulfill irrigation needs of farmers not connected to grid
- Solarization of existing grid-connected agriculture pumps to make farmers independent of grid supply and also enable them to sell surplus solar power generated to DISCOM and get extra income
- Solarization of tube-wells and lift irrigation projects of Government sector

**2.2.6 Trina Solar launches TrinaPro smart PV solution**

The world's largest solar photovoltaic (PV) maker, China's Trina Solar, launched its smart PV solution TrinaPro that combines its solar modules with a solar tracker system and inverter.

Highlights:

- TrinaPro will help improve system stability with higher power generation and lower costs by reducing system losses.

- It reduce losses by 10 per cent.
- By interconnecting 'Edge Computing' and a smart operations and maintenance (O&M) system on a cloud platform, TrinaPro can analyse and process data from the cloud to optimise the system's operation model and ensure that it runs smoothly and efficiently,

### 2.2.7 International Solar Alliance

French President together with the Indian Prime Minister officially launched the International Solar Alliance (ISA). The idea was presented alongside the historical Paris Agreement

Highlights:

- ISA aims to deploy 1,000 GW of solar installations globally by 2030.
- Aside from large-scale deployment, this international collaboration looks to provide open access to research, technology, best practices and standards on solar energy.
- The 121 ISA member countries (countries lying between the Tropic of Cancer and Tropic of Capricorn) vary significantly in terms of energy access rates, regulatory frameworks and economic development
- The ISA works through country appointed National Focal Points (NFP)

### India commits \$1.4 billion for solar energy worldwide

- India announced one of the world's largest investment plans in solar energy at the Founding Conference of the International Solar Alliance (ISA).

### NDB and ISA tie up to promote solar energy

New Development Bank (NDB) and International Solar Alliance(ISA) have joined hands to promote solar energy across the globe

- The parties will mutually support the implementation of the NDB's and ISA's plans for solar energy development and deployment through technical assistance and knowledge transfer.

### ADB and ISA sign pact

- The cooperation envisages solar power generation, solar based mini-grids, and transmission systems for integrating solar energy into grids, among others.
- The ISA and the ADB would also cooperate on knowledge sharing and developing technology roadmaps for the promotion of solar energy
- They would also develop financing instruments to support solar energy deployment and conduct studies and consultations to explore mobilisation of concessional financing through trust funds or special funds administered by ADB.

## 2.3 Biofuels

### 2.3.1 National Policy on Biofuels - 2018

The Policy categorises biofuels to enable extension of appropriate financial and fiscal incentives.

a. "Basic Biofuels" - First Generation (1G) - bioethanol & biodiesel

b. "Advanced Biofuels" - Second Generation (2G) - ethanol, Municipal Solid Waste (MSW), drop-in fuels and Third Generation (3G) biofuels, bio-CNG etc.

- First generation biofuels are made from sugars via molasses and vegetable oils
- Advanced biofuels are made from lignocellulosic biomass or woody crops, agricultural residues and municipal waste.

**The policy aims:**

- a. Use of surplus food grains for production of ethanol for blending with petrol.
- b. Viability gap funding scheme for 2G ethanol Bio refineries
- c. Setting up of supply chain mechanisms for biodiesel production from non-edible oilseeds, used Cooking Oil, short gestation crops.
- d. It allows for a wider variety of raw materials to be used as inputs to produce ethanol that is blended with petrol. Envisages investment to the tune of ₹5,000 crore in building bio-refineries and offering other incentives The Policy encourages setting up of supply chain mechanisms.

**Benefits**

- Reduce dependency on imports
- Cleaner environment: The decline in crop burning and conversion of agricultural wastes to biofuels
- Health benefits: Prolonged reuse of cooking oil for preparing food such as deep-frying is a potential health hazard. The use of old cooking oil for making biodiesel will prevent the practice of used cooking oil in the food industry.
- Management of municipal solid waste: One ton of such waste has the potential to provide around 20 percent drop in fuels.
- Boost infrastructural investment in rural areas: At present Oil Marketing Companies are in the process of setting up 12 2G bio refineries.
- Additional income to farmers: The conversion of surplus grains and agricultural biomass to ethanol.

**Drop-in biofuels**

- Renewable hydrocarbon biofuels or drop-in biofuels are fuels produced from biomass sources through a variety of biological and thermochemical processes.
- These products are similar to petroleum gasoline, diesel, or jet fuel in chemical makeup and are therefore considered infrastructure-compatible fuels.
- They can be used in vehicles without engine modifications and can utilize existing petroleum distribution systems

**2.3.2 Plant microbial fuel cells (PMFC)**

- While the plant above the ground does photochemistry, the bacteria beneath do electrochemistry, generating positive and negative ions
- To place positive and negative electrodes in appropriate positions and obtain an electric current, just as we do with batteries. This method of producing electricity is through what is termed as plant microbial fuel cells (PMFC).
- The method is completely natural and environment-friendly, needs no externally added material and is part of a cyclic process in nature.

**2.3.3 Microbes help in making hydrocarbons**

Scientists at the International Centre for Genetic Engineering and Biotechnology (ICGEB), New Delhi, have succeeded in engineering the metabolic pathway of *Escherichia coli* in such way that it would

synthesise hydrocarbons of carbon chain length 15 and 17, which are the fundamental components of diesel.

**Highlights:**

- A total of three gene additions and eight gene deletions were carried out to increase the hydrocarbon production rate and concentration.
- The added genes included those which code for cyanobacterial alkane producing enzymes and a host gene which can lead to availability of higher electrons needed for alkane production.
- The deletions helped in saving the substrate (glucose) from going to other competing products, and also helped in limiting the cell growth so that more carbon is available for alkane formation.
- The pathway engineering also led to higher production of fatty alcohol, which has a role in cosmetic industries.

**2.3.4 Artificial leaf that creates biofuel**

IISc scholars have developed an artificial 'leaf' that'll help reduce carbon footprint and create biofuel.

**Key findings:**

- The researchers used copper aluminium sulphate and zinc sulphide.
- The two materials, which are otherwise wide band gap semiconductors, became low band gap semiconductors when combined.
- The lower the band gap, the better conductivity a substance will have.
- Basically, for photosynthesis or the process of plants taking in carbon dioxide to produce oxygen and glucose. For this process to happen, a high energy photon, electron and sunlight are needed.
- The electron needs to have a lot of kinetic energy.
- This quantum leaf had a much better rate of energy conservation compared to natural leaves – 20% as compared to 0.4-0.5% in photosynthesis.

**Wide band gap semiconductors and low band gap semiconductors**

- The term "band gap" refers to the energy difference between the top of the valence band and the bottom of the conduction band.
- Electrons are able to jump from one band to another.
- Wide-band gap semiconductors (WBG or WBGs) are semiconductor materials which have a relatively large band gap compared to typical semiconductors.
- Typical semiconductors like silicon have a band gap in the range of 1 - 1.5 electron volt (eV), whereas wide-band gap materials have band gaps in the range of 2 - 4 eV.

**2.3.5 India's first 2G biofuel plant**

Bharat Petroleum Corporation Ltd (BPCL)'s ethanol bio-refinery at Bausingha village in Bargarh district of Odisha.

**Highlights:**

- The ethanol will be produced from rice straw.
- Ethanol will be blended with petrol and used as fuel
- BPCL is planning to set up two such plants at Madhya Pradesh and Maharashtra soon.

### 2.3.6 Policy on biofuel for aviation sector

Supports the use of biofuels from non-edible oils for powering jet engines.

Highlights:

- The civil aviation ministry will set the standards for biofuel to be used as jet fuel
- The fuel was developed by the Indian Institute of Petroleum (IIP) in Dehradun.
- Fuel standard non-edible oils have to be produced on a commercial scale.
- A blend of 75% of aviation turbine fuel and 25% of biojet fuel has the potential of reducing carbon footprint by 15%.
- The technology for making biofuel from non-edible oilseeds is available and the proposed policy will help commercialise the technology

#### India's first biofuel plane

- India's first biofuel plane could fly from Dehradun to Delhi by Spicejet Operator.
- Jatropha powers India's first biofuel flight

### 2.3.7 SATAT initiative

To set up Compressed Bio-Gas (CBG) production plants and make available CBG in the market for use in automotive fuels.

Highlights:

- The initiative is aimed at providing a Sustainable Alternative Towards Affordable Transportation (SATAT).
- Efficient municipal solid waste management and in tackling the problem of polluted urban air due to farm stubble-burning and carbon emissions.
- To bring down dependency on crude oil imports
- Enhancing farmers' income, rural employment and entrepreneurship.

#### About Compressed Bio-Gas:

- Bio-gas is produced naturally through a process of anaerobic decomposition from waste / bio-mass sources like agriculture residue, cattle dung, sugarcane press mud, municipal solid waste, sewage treatment plant waste, etc.
- After purification, it is compressed and called CBG, which has pure methane content of over 95%.
- Compressed Bio-Gas is exactly similar to the commercially available natural gas in its composition and energy potential.
- Compressed Bio-Gas can be used as an alternative, renewable automotive fuel.

### 2.3.8 Biodiesel from used cooking oil

The Biodiesel Association of India (BDAI) to manufacture biodiesel from used cooking oil.

Highlights:

- The RUCO (Repurpose Used Cooking Oil) app will help manage collection of used cooking oil from food vendors and processing units and supply it to biodiesel manufacturers.
- An amendment in the Food Safety and Standards Authority of India (FSSAI) Act, has made edible oils with total polarized compound (TPC) values beyond 25 per cent unsafe for human consumption.

- When edible oil is heated, its total polarised compound (TPC) value increases

## 2.4 Wind Energy

### 2.4.1 Largest Wind Mill

- The first prototype of S128 has been commissioned at the Sangneri site in Tamil Nadu
- The S128 wind turbine generator is the latest addition to Suzlon's product portfolio and features the doubly fed induction generator (DFIG) technology.
- The windmill also consists of the country's largest rotor blade measuring 63 meters and has a rotor diameter of 128 meters.
- The SB 63 blade has been engineered and developed by Suzlon utilising carbon fibre which provides the capability to utilise thinner aerodynamic profiles.
- This next generation turbine is well equipped to improve energy yield and support competitive tariff environment in India while protecting customers return on investment (ROI).



### 2.4.2 Environmental impact of wind energy

As the country tries to achieve an ambitious renewable energy target of 175 GW, windmills have popped up in at least 65 sq km of forested area. This has often led to expressions of concern over the environmental impact.

- Global scientific research has highlighted the impact of windmills on wildlife.
- In Rajasthan, transmission lines and spinning blades have reportedly led to increasing mortalities of the critically-endangered Great Indian Bustard.
- Currently, the guidelines for wind energy skirt wildlife impact
- The process for forest land diversion focuses primarily on compensatory afforestation

### 2.4.3 National Wind-solar Hybrid Policy

- The objective of the policy is to provide a framework for promotion of large grid connected wind-solar PV hybrid system for efficient utilization of transmission infrastructure and land.
- It also aims at reducing the variability in renewable power generation and achieving better grid stability.
- On technology front the Policy provides for integration of both the energy sources i.e. wind and solar at AC as well as DC level
- The Policy seeks to promote new hybrid projects as well as hybridisation of existing wind/solar projects
- The Policy provides for procurement of power from a hybrid project on tariff based transparent bidding process for which Government entities may invite bids.

- Policy permits use of battery storage in the hybrid project for optimising the output and further reduce the variability.
- It mandates the regulatory authorities to formulate necessary standards and regulations for wind-solar hybrid systems.

## 2.5 Alternate Fuels

### 2.5.1 Germany rolls out world's first hydrogen train

Germany rolled out the world's first hydrogen-powered train, a costlier but more eco-friendly technology.

#### Highlights:

- First run was between the towns and cities of Cuxhaven, Bremerhaven, Bremervoerde and Buxtehude in northern Germany .
- Hydrogen trains are equipped with fuel cells that produce electricity through a combination of hydrogen and oxygen, a process that leaves steam and water as the only emissions.
- Excess energy is stored in ion lithium batteries on board the train.
- A hydrogen train is somewhat more expensive than a diesel train, but it is cheaper to run.



### 2.5.2 China's Artificial moon Project

China is planning to launch its own 'artificial moon' by 2020 to replace street lamps and lower electricity costs in urban areas.



#### About the Project:

- The satellite will bear a reflective coating to cast sunlight back to Earth, where it will supplement streetlights at night.
- It could be eight times more luminous than the actual, original moon.
- It will also orbit much closer to Earth; about 500 km (310 miles) away



### 2.5.3 Coal Based Methanol As Alternative Fuel

NITI Aayog has set up an Apex Committee and five Task Forces for carrying out R&D and development roadmap for implementing Methanol economy in India.

Highlights:

- A 15% methanol blending can result in replacement of around 31.9 million tons of crude oil.
- It can result in significant savings for India.
- The carbon monoxide (CO) and Hydrocarbons (HC) emission reduction for M 15 as compared to neat gasoline by approximate 40 % is an added benefit
- Envisaging Carbon dioxide (CO<sub>2</sub>) and evaporative emission benefits.

## 3. ENERGY CONSERVATION

### 3.1 Energy Efficient Buildings

#### 3.1.1 Energy-positive campus

The Energy Management Centre (EMC), an autonomous institution under the Kerala government, has grabbed the global spotlight for its energy-positive campus:

- Towards a zero-emission, efficient, and resilient buildings and construction sector,' published by the United Nations Environment Programme (UNEP), has listed the EMC campus as one of the recent achievements in the deployment of key technologies for energy-efficiency in buildings.
- It is the only one from India to figure in the list, along with five other projects worldwide
- It was designed to allow natural cross-flow ventilation from building forms and openings.
- Campus uses daylighting controls, CFC-free heating, ventilation and cooling systems, along with a halogen-free fire-fighting system.
- Solar reflectance index coating, combined with high-albedo painting and turbo-vents for passive cooling, has been used, and tropical rainforest trees help create cool surroundings.
- Only certified green construction materials, recycled wood boards, low-emitting paints and adhesives, and green-plus certified carpets have been used.

#### Solar reflectance index coating:

- Solar reflectivity or reflectance is the ability of a material to reflect solar energy from its surface back into the atmosphere.
- The SR value is a number from 0 to 1.0.
- A value of 0 indicates that the material absorbs all solar energy and a value of 1.0 indicates total reflectance.

#### Albedo painting:

- It is an eco-friendly paint which upon application to cementaceous, asbestos or MS roofing, increases the emissivity of that surface, which results in reflection of heat energy

#### 3.1.2 LEED Gold Certification:

- LEED (Leadership in Energy and Environmental Design) is a green building rating system used across the world for all building project types including schools and colleges.
- A framework is provided by LEED which can be adapted by institutions to create an efficient, healthy and sustainable green buildings

- The Green Business Certification Institute(GBCI), is the organisation which certifies all LEED green building projects.
- In India, there are currently around 2,500 ongoing LEED projects of which, many are educational institutions.

**3.2 Energy Efficiency**

**3.2.1 India Energy Efficiency Scale-Up Program**

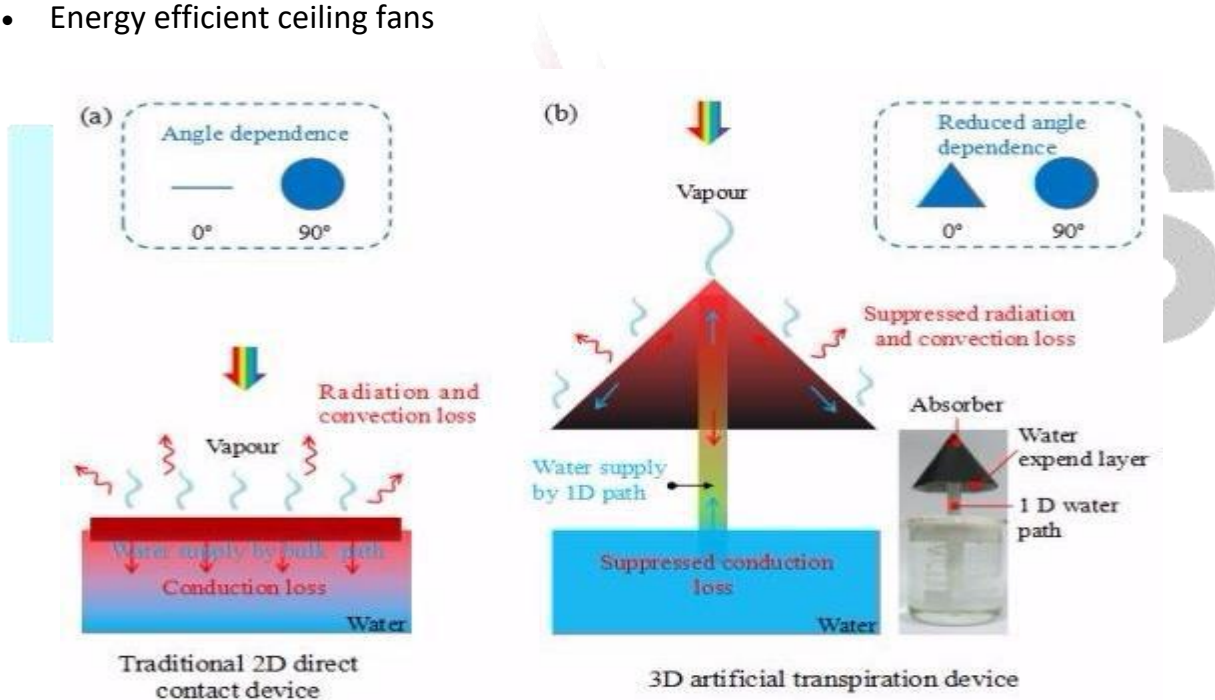
The Government of India, the EESL, and the World Bank signed a \$220 million Loan Agreement for the India Energy Efficiency Scale-Up Program.

**Highlights:**

- The investments under the programme are expected to avoid lifetime greenhouse gas emissions of 170 million tons of CO<sub>2</sub>

**The key components:**

- Creating sustainable markets for LED lights
- Energy efficient ceiling fans



- Facilitating well-structured and scalable investments in public street lighting
- Developing sustainable business models for emerging market segments such as super-efficient air conditioning and agricultural water pumping systems
- Strengthening the institutional capacity of EESL.

**3.2.2 State energy efficiency preparedness index**

The Bureau of Energy Efficiency (BEE) has come up with the country’s first state energy efficiency preparedness index.

**Highlights:**

- The index will help track the progress in managing the energy footprint of states and the country
- To encourage competition between states
- Help in programme implementation.
- The index is based on 63 indicators in sectors such as buildings, industry, municipalities, transport, agriculture and electricity distribution companies (discoms).
- These indicators are based on metrics such as policy and regulation, financing mechanisms, institutional capacity, adoption of energy efficiency measures and energy savings achieved

**3.2.3 India's first filament bulb-free village panchayat**

- Pilicode panchayat in Kasaragod, Kerala
- The panchayat achieved this rare distinction by replacing all the filament bulbs by LED bulbs
- As part of the project, the panchayat had conducted a survey in all the households with regards to the use of electric bulbs and other electric gadgets, and also got the details about the energy-inefficient gadgets

**3.2.4 3D conic device to increase solar-thermal conversion**

Chinese scientists have developed a new device of 3D hollow-cone structure that can greatly increase the solar-thermal conversion efficiency.

**Highlights:**

- The device, named 'Artificial Transpiration' is inspired by the transpiration process of trees
- It has a special 1D water path within it, which can reduce the energy loss in conduction
- The cone structure, based on a graphene film, can collect more sunlight throughout the day when compared with a flat device, as about 10 per cent to 50 percent of sunlight is diffusive
- The device can enhance the solar-thermal conversion rate to 85 per cent, which is much higher than the 40 per cent rate of common devices
- The structure can be further optimised to have a longer life and recycle more heavy metals

**3.2.5 The Chiller Star Labeling program**

The Chiller Star Labeling program has been formulated by Bureau of Energy Efficiency (BEE)

**Highlights:**

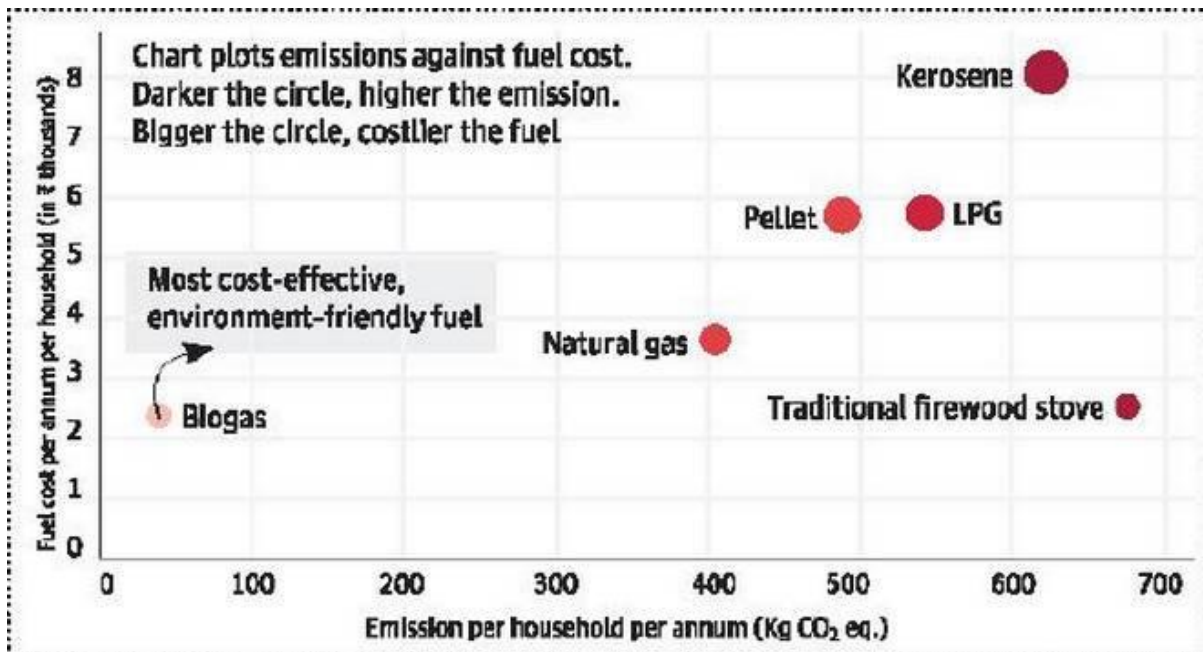
- The program envisages providing star rating in its energy performance.
- The initiative will promote the advancement technology for central HVAC system
- It will facilitate energy efficient solutions for the commercial and industrial applications

**About Chillers:**

- They are used extensively for conditioning and building applications
- Chillers, being energy intensive system, contributed more than 40 percent of total electricity consumption in commercial buildings.

### 3.3 Clean Fuels

#### 3.3.1 A clean cooking strategy



Need:

- Affordable, reliable and clean energy for cooking is essential y for reducing health and environmental impacts
- Helping women to do more productive work and developing the rural economy.

Comparing the options:

- Biogas accounts for the lowest effective greenhouse gas emission; PNG and then LPG are next

Initiatives:

National level programmes to ensure that most switch to clean cooking fuels have been initiated since the 1980s.

- National Project on Biogas Development (NPBD)
- Pradhan Mantri Ujjwala Yojana - a cumulative target of providing LPG connections to more than eight crore families

#### 3.3.2 Pradhan Mantri Ujjwala Yojana

- It aims to provide LPG (liquefied petroleum gas) connections to poor households.
- Under the scheme, an adult woman member of a below poverty line family identified through the Socio-Economic Caste Census (SECC) is given a deposit-free LPG connection with financial assistance of Rs 1,600 per connection by the Centre.
- Eligible households will be identified in consultation with state governments and Union territories.
- The scheme is being implemented by the Ministry of Petroleum and Natural Gas.

**Objectives of the scheme:**

- Empowering women and protecting their health.
- Reducing the serious health hazards associated with cooking based on fossil fuel.
- Reducing the number of deaths in India due to unclean cooking fuel.
- Preventing young children from significant number of acute respiratory illnesses caused due to indoor air pollution by burning the fossil fuels.

**First smoke-free State**

Kerala is set to become the first smoke-free State in the country with public sector oil companies eyeing 100% LPG penetration.

**Extended Pradhan Mantri Ujjwala Yojana**

- The target under the Centre's flagship scheme is raised to 8 crore with additional allocation of fund in the current fiscal 2018-19
- The extended Pradhan Mantri Ujjwala Yojana would now cover all SC/ST households, Most Backward Classes, beneficiaries of Pradhan Mantri Awas Yojana (Gramin), Antyoday Anna Yojana, forest dwellers, people residing in river and river islands.

**3.4 Energy Storage****3.4.1 National Energy Storage Mission**

The draft National Energy Storage Mission expects to kick-start grid-connected energy storage in India, set up a regulatory framework, and encourage indigenous manufacture of batteries

**Highlights:**

- The mission will focus on seven verticals: indigenous manufacturing; an assessment of technology and cost trends; a policy and regulatory framework; financing, business models and market creation; research and development; standards and testing; and grid planning for energy storage.

**3.4.2 Lithium Ion Battery project**

Central Electrochemical Research Institute (CECRI), Karaikudi, Tamil Nadu under Council of Scientific & Industrial Research (CSIR) is to transfer of technology for India's first Lithium Ion (Li-ion) Battery project.

- Currently, Indian manufacturers source Lithium Ion Battery from China, Japan and South Korea among some other countries.
- India is one of the largest importers and in 2017

**Li-Ion batteries**

- Li-Ion batteries have applications in Energy Storage System – from hearing aid to container sized batteries to power a cluster of villages, Electric Vehicles (2-wheeler, 3-wheeler, 4-wheeler and Bus), portable electronic sector, Grid Storage, Telecom and Telecommunication Towers, Medical Devices, Household and Office Power Back (UPS), Powering Robots in Processing Industry.
- A lithium-ion battery or li-ion battery is a type of rechargeable battery in which lithium ions move from the negative electrode to the positive electrode during discharge and back when charging.

- Li-ion batteries use an intercalated lithium compound as one electrode material, compared to the metallic lithium used in a non-rechargeable lithium battery.

### 3.5 Transportation

#### 3.5.1 Delhi becomes first city to roll-out Euro VI fuel

New Delhi has become the first city in India to deploy Bharat Stage 6 Fuel for both petrol and diesel, two years ahead of the rest of the county to help battle Delhi's long-standing terminal pollution problem.

#### **Bharat Stage (BS) VI**

- The proposed Bharat Stage (BS) VI regulation for on-road vehicles in India includes contains both emission standards for new vehicles as well as specifications for reference and commercial gasoline and diesel fuels
- Sulfur content is limited to a maximum of 10 ppm in the proposed BS VI regulation, which matches global best practices.
- While proposed BS VI fuel specifications largely follow European regulations, proposed limits for several commercial gasoline and diesel fuel parameters in India differ from EU values
- By 2023-2025 time frame, India should try to match, or even improve upon, Euro 6/VI fuel specifications.

#### 3.5.2 Charging points for EVs every 3 km

The government proposes to set up charging stations for electric vehicle every three kilometres in cities with million-plus population and smart cities, and every 50 km on busy national highways.

#### Highlights:

- It is likely to offer fiscal incentives and facilitate land from municipal authorities for those interested in setting up the infrastructure, which is a key requirement for the proliferation of electric vehicles.
- Public sector undertakings in the energy sector such as National Thermal Power Corporation Limited, Power Grid Corp and Indian Oil Corp are likely to initiate the process to set up charging stations at several locations in identified cities.

#### 3.5.3 MOVE: Global Mobility Summit

NITI Aayog, in collaboration with various ministries and industry partners,organised 'MOVE: Global Mobility Summit' in New Delhi.



#### Highlights:

- It will be the first Global Mobility Summit of its kind.
- The summit will help drive Government's goals for vehicle electrification, renewable energy integration and job growth and also speed up India's transition to a clean energy economy.
- It aims to bring together and engage with key stakeholders and to evolve a public interest for a shared, connected, zero emission and inclusive mobility agenda for the future
- The six tracks or themes for the Summit will focus on:
  - a. Asset Utilization and Services
  - b. Comprehensive Electrification
  - c. Alternative Energy
  - d. Reinventing Public Transit
  - e. Logistics and Goods Transport
  - f. Data Analytics and Mobility

## 4. FOSSIL FUELS

### 4.1 Infrastructure

#### 4.1.1 India's emergency oil reserve

##### Highlights:

- The plan is to build underground caverns that can hold a combined 6.5 million tons of crude at two locations
- The two new reserves include 4 million tons of storage at Chandikhol in the eastern state of Odisha and a 2.5 million-ton facility at Padur in southern India's Karnataka.
- The state-run ISPRL will collaborate with private entities, who will invest in the project
- Expanding strategic petroleum reserves to shield the economy from oil-price volatility.
- The new SPRs will be sufficient to cover the country's oil needs for another 12 days

#### 4.1.2 Online portal for pipelines

The Ministry of Petroleum and Natural Gas launched an online portal for enabling easy, efficient and transparent booking of Common carrier capacity for natural gas transmission services under GAIL's pipelines.

##### Highlights:

- It would be a first step to facilitate gas trading on hub or exchange traded platform in India.
- It will enable the new entities to utilize the GAIL's infrastructure in procuring the gas in a cost-effective manner
- To provide gas consumers the facility to register pipeline capacity bookings online and endeavours to continue the practice of serving on first come-first serve basis.

#### 4.1.3 World's largest greenfield oil refinery

A consortium of India's three state-run Oil Marketing Companies (OMCs) signed an agreement with Saudi Aramco, the world's largest producer of crude oil, to set up the world's largest greenfield integrated oil refinery on the west coast of India.

- The project will have Saudi Aramco as a 50 percent equity partner and the rest 50 per cent will be held by the Indian consortium

### 4.2 Exploration

#### 4.2.1 Exploration and Exploitation of Unconventional Hydrocarbons

The Union Cabinet has approved the policy to permit exploration and exploitation of unconventional hydrocarbons such as Shale oil/gas, Coal Bed Methane (CBM) etc.,

##### Highlights:

- It will be carried out under the existing Production Sharing Contracts (PSCs), CBM contracts and Nomination fields to encourage the existing Contractors in the licensed/leased area to unlock the potential of unconventional hydrocarbons in the existing acreages.
- The policy envisages new investment in Exploration and Production (E&P) activities and chances of finding new hydrocarbon discoveries and resultant increased domestic production thereof is expected.
- To induction of new, innovative and cutting-edge technology and forging new technological collaboration.

##### Production Sharing Contract (PSC):

- Production Sharing Contract (PSC) is a term used in the Hydrocarbon industry and refers to an agreement between Contractor and Government whereby Contractor bears all exploration risks, production and development costs in return for its stipulated share of (profit from) production resulting from this effort.
- The costs incurred by the contractor are recoverable in case of commercial discovery.
- Production Sharing Contracts became widely adopted as part of the New Exploration and Licensing Policy (NELP) launched by the Government in 1997



### Hydrocarbon Exploration and Licensing Policy (HELP)

- Hydrocarbon Exploration and Licensing Policy (HELP) is a policy adopted by Government of India on 2016 indicating the new contractual and fiscal model for award of hydrocarbon acreages towards exploration and production (E&P).
- HELP replaces New Exploration Licensing Policy (NELP).

#### Features of HELP:

- Uniform License: It provides for a uniform licensing system to cover all hydrocarbons such as oil, gas, coal bed methane etc. under a single licensing framework, instead of the present system of issuing separate licenses for each kind of hydrocarbon
- Open Acreages: It gives the option to a hydrocarbon company to select the exploration blocks throughout the year without waiting for the formal bid round from the Government
- Revenue Sharing Model: Present fiscal system of production sharing contract (PSC) is replaced by an easy to administer “revenue sharing model”.
- Marketing and Pricing Freedom has been granted, subject to a ceiling price limit, for new gas production from Deepwater, Ultra Deepwater and High Pressure-High Temperature Areas.
- Fuel oil import landed price
- Exploration is allowed through-out the contract period.

#### 4.2.2 Discovered Small Field Policy

- Launched in 2016
- The motive is extracting the Oil, Natural gas from the un-monetized small oil/gas discoveries that are available in the country.
- It provides an easy investment option for new and existing players with minimal risk.
- The Government is now rolling out DSF Bid Round-II which is offering larger field areas in commercially producing basins

#### 4.2.3 Enhanced Recovery Methods for Oil and Gas

The Union Cabinet has approved the Policy framework to promote and incentivize Enhanced Recovery (ER)/ Improved Recovery (IR)/ Unconventional Hydrocarbon (UHC) production Methods/techniques.

#### Highlights:

- To improve recovery factor of existing hydrocarbons reserves.
- The ER includes Enhanced Oil Recovery (EOR) and Enhanced Gas Recovery (EGR), Unconventional Hydrocarbon (UHC) production methods include Shale oil and gas production, tight oil and gas production, production from oil shale, gas hydrates and heavy oil.
- These are capital intensive, technologically complex and challenging in nature
- The strategic objective of the Policy is to build a supportive ecosystem through academic and research institutes, industry- academia collaboration and to support and encourage Exploration and Production (E&P) Contractors.
- The Policy will be applicable to all contractual regimes and Nomination fields.
- The Policy envisages systemic assessment of every field for its ER potential, appraisal of appropriate ER techniques and fiscal incentives.

#### 4.2.4 Policy framework for Production Sharing Contracts

Policy framework for streamlining the operations of Production Sharing Contracts (PSCs) for increased domestic production of hydrocarbon resources.

The framework:

- Special dispensation for exploration & production (E&P) activities in North Eastern Region (NER)
- Sharing of Royalty and Cess in Pre-NELP (New Exploration Licensing Policy) Exploration Blocks
- Extending tax benefits to operational blocks under Pre-NELP discovered fields
- Relaxing the timeline from for giving written notice to notify the occurrence of an unforeseeable circumstances that prevent fulfilling of contract.

#### 4.2.5 Coal auction reforms

An high-power committee, headed by former Central Vigilance Commission Pratyush Sinha, has recommended a complete overhaul of regulations governing mine auctions.

Proposals:

- Bidding on revenue share basis
- Allowing captive mines to sell part of the output in the market
- Easing of bank guarantees
- Linking the value of to-be-auctioned blocks with a proposed monthly coal index which is to be developed on the basis of the prevalent spot price and rates for captive mining, international markets and Coal India.
- Flexibility in coal mining to captive bidders in line with requirements of the attached end-use plants.

#### Captive coal mining

- means that the coal mined could be used only in the said industry for which the allocation/auction of the block has been done.
- It can't be used for any other purposes

#### 4.2.6 Methanol Fuel

##### Blending LPG with Methanol:

- Blending 20% methanol with LPG estimated to cut cost of gas for household consumption by ₹100 a cylinder
- The project would be piloted by the NITI Aayog.
- The plan is to produce methanol from abundantly available low-quality coal and other bio resources.
- The gaseous form, Methanol - DME, can be blended in 20% ratio with LPG.

##### Benefits:

- Reduces dependency imports
- Environmental benefits
- Saves consumption cost
- Reduces government burden on subsidies

**About Methanol:**

- Methanol is a liquid chemical
- It is colorless, volatile, flammable, and poisonous.
- Methanol is made from the destructive distillation of wood and is chiefly synthesized from carbon monoxide and hydrogen.
- Its principal uses are in organic synthesis, as a fuel, solvent, and antifreeze.

**5. NUCLEAR ENERGY****5.1 Nuclear Fusion****5.1.1 Fusion Energy Conference (FEC 2018)**

The 27th IAEA Fusion Energy Conference (FEC 2018) is scheduled to be held in Gandhinagar, Gujarat.

**The conference:**

- It was organised by the International Atomic Energy Agency (IAEA) and hosted by Department of Atomic Energy and Gandhinagar-based Institute of Plasma Research.
- The conference aims to provide a forum for the discussion of key physics and technology issues as well as innovative concepts of direct relevance to the use of nuclear fusion as a source of energy.
- The conference will also set these results against the backdrop of the requirements for a net energy producing fusion device and a fusion power plant in general, and will thus help in defining the way forward.
- To reflect the priorities of this new era in fusion energy research.

**About IAEA:**

- The International Atomic Energy Agency (IAEA) is an international organization that seeks to promote the peaceful use of nuclear energy.
- To inhibit its use for any military purpose, including nuclear weapons.
- The IAEA has its headquarters in Vienna, Austria.
- The IAEA reports to both the United Nations General Assembly and Security Council
- The IAEA serves as an intergovernmental forum for scientific and technical co-operation in the peaceful use of nuclear technology and nuclear power worldwide

**5.2 Nuclear Plants****5.2.1 Kudankulam power plant waste disposal**

The Supreme Court granted the Nuclear Power Corporation of India Ltd. (NPCIL) an extension of time, to build an Away From Reactor (AFR) facility to store spent nuclear fuel from the Kudankulam power plant.

- KNPP is the single largest nuclear power station in India.
- It is scheduled to have six VVER-1000 reactors with an installed capacity of 6,000 MW of electricity.
- It has been built in collaboration with Atomstroyexport, the Russian state company and NPCIL

### Away From Reactor (AFR) facility

The nuclear waste is stored temporarily at a site far from the nuclear plant. It helps

- Safety of the nuclear plant from accident
- Centralized Storage

### 5.2.2 Russia to set up more nuclear reactors in India

India and Russia signed a document for cooperation on a new nuclear power project in India with the latest VVER-1200 type reactors powered by advanced fuel.

#### Key Facts of the agreement:

- To implement the project of six nuclear power units of Russian design at a new site in India
- Cooperation in third countries in new promising areas of nuclear technology apart from the construction of nuclear power plants
- Russia will offer the reference evolutionary VVER-1200 technical solutions of the generation "3+" reactors for the new nuclear project
- Russia will increase the level of Indian industry's involvement and localisation of manufacturing equipment for nuclear power plants in the framework of the policy 'Make in India'
- Optimise the timing and the cost of project implementation.
- India is collaborating with Russia in setting up Bangladesh's first nuclear plant at Rooppur.

### 5.2.3 Exploitation of Atomic Minerals

Atomic Minerals Directorate for Exploration and Research (AMD), a constituent unit of Department of Atomic Energy (DAE), has the mandate to identify, evaluate and augment mineral resources of uranium, thorium, niobium, tantalum, beryllium, lithium, zirconium, titanium, rare earths (containing uranium and thorium) besides beach sand minerals like garnet and sillimanite .

AMD has identified adequate resources of atomic minerals in the country. The details of the resources of atomic minerals are below:

- Uranium – uranium oxide (U<sub>3</sub>O<sub>8</sub>)
- Beach Sand Minerals [BSM]
  - Thorium (as monazite)
  - The mineral monazite, containing ~ 55 - 60% total Rare Earth Elements (REE), is also the major resource for REE
  - Titanium (as ilmenite, leucosene and rutile)
  - Zirconium (as zircon)
  - Garnet
  - Sillimanite
- The mining lease deed between the applicant and the State Government is executed by the respective State Governments
- At present, uranium deposits established by AMD are mined by Uranium Corporation of India Limited (UCIL), a PSU of DAE.



- In respect of beach sand minerals, the mining operations are being carried out by both PSUs and private entrepreneurs.
- In respect of other atomic minerals like beryl, columbite, tantalite, lepidolite etc., no specific mining operations are being carried out.

#### 5.2.4 Floating nuclear power plant (FNPP)

- An FNPP is basically a mobile, low-capacity reactor unit operable in remote areas isolated from the main power distribution system, or in places hard to access by land.
- They are designed to maintain both uninterrupted power and plentiful desalinated water supply in remote areas.
- The Russian "Academik Lomonosov" is the world's first floating nuclear power plant
- Akademik Lomonosov will replace Pevek's aging Bilibino Nuclear Power Plant and Chaunsk coal-fired power plant, saving about 50,000 tons of CO<sub>2</sub> emissions per year compared to the current levels

### 6. TRANSMISSION AND DISTRIBUTION

#### 6.0.1 PRAAPTI App and Web

A Web portal and an App namely PRAAPTI (Payment Ratification And Analysis in Power procurement for bringing Transparency in Invoicing of generators) and PRAAPTI App has been developed to bring transparency in power purchase transactions between Generators and Discoms.

- The App and Web Portal will capture the Invoicing and payment data for various long term PPAs from the Generators.
- The app will also allow users to know the details related to the payments made by the Discoms to the power generation company and when they were made.
- PRAAPTI will also enable the consumers to evaluate financial performance of their Discoms in terms of payments being made to the generation companies.
- The Portal would also help DISCOMs and GENCOs to reconcile their outstanding payments.
- The portal would facilitate relative assessment of various State DISCOMs on "Ease of making payments" to various Generation Companies, and will also help make transactions in the power Sector more transparent.

#### 6.0.2 Power grid Digitalisation

Benefits:

- To enhance grid reliability through access to real time information and remote management.
- The utilities stand to increase savings through operational efficiency and earn income through new revenue streams
- It transforms the grid from uni-directional to multi-directional
- Enabling distributed generation and encouraging the integration and consumption of renewable energy.
- The transparency across the value chain
- The access to actionable intelligence.
- More information is now available on assets, behavior, and demand
- The information can be leveraged to create value for everyone.

### 6.0.3 Smart electricity meters

Under the Uday scheme old meters are being replaced with new smart meters. It was done in district Panipat as a pilot project.

- Energy Efficiency Services Limited (EESL), a joint venture of PSUs under Union Ministry of Power will assist the state discoms through the Smart Meter National Programme (SMNP).
- First in the states of Haryana and Uttar Pradesh, states with AT&C losses as large as 28.42% and 34.36% respectively

#### About Smart Meters and Smart Grids

- The first step towards realising Smart Grids is the implementation of Advanced Metering Infrastructure (AMI).
- AMI is a collective term for an integrated infrastructure of Smart Meters, two way-communication networks, control centre equipment, and the applications that enable near real-time gathering and transfer of energy usage information.
- A smart, automated metering system reduces meter-reading, data-entry errors and costs
- These meters are connected through a web-based monitoring system
- These smart meters would be GPRS equipped

Advantages of Smart meters:

- To improve the financial condition of power distribution companies
- Smart Meter can enable utilities to reduce their Aggregate Transmission and Commercial (AT&C) losses and billing inefficiencies
- To encourage energy conservation
- To tackle problems relating to payment of electricity bills.
- This would enable electricity distribution companies to collect real time data on usage

#### Build-Own-Operate-Transfer (BOOT) model

- EESL will undertake all the capital and operational expenditure with zero upfront investment from states and utilities.
- EESL, on its investment, shall earn through a mutually agreed automated payback structure, along with payment security mechanism from state governments and utilities.

### 6.0.4 Saubhagya scheme

The Saubhagya Scheme or Pradhan Mantri Sahaj Bijli Har Ghar Yojana is an Indian government project to provide electricity to all households.

Key Facts:

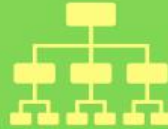
- The project was announced in September 2017
- It the aim to complete the electrification process by December 2018
- Certain households identified via the Socio-economic and Caste Census (SECC) of 2011 will be eligible for free electricity connections, while others will be charged 500 Rs
- The beneficiary household will get five LED lights, one AC fan, one AC power plug.
- It also includes the Repair and Maintenance (R&M) for 5 years

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