Infrastructure- Part 1

Energy Sector

The power sector in India is undergoing a major transformation with drastic changes expected in the market structures, supply mix as well as in consumption patterns. Several of these changes are influenced by happenings in the global energy markets – focus on renewables owing to concerns on climate change and supported by drastic cost reduction, increased proliferation of Electric Vehicles driven by gradual improvement in electric storage, and technology advancement in grid management and power generation systems.

Energy is a vital input into production. If India wants to maintain its 9% growth rate in the next 2 decades, it must ensure uninterrupted power supply to all its industries, agricultural and domestic purposes. Rapid economic growth cannot be achieved by if energy is not available at reasonable costs. This is possible only with appropriate long term planning, adequate investments to generate power for future requirements with support from appropriate policies. With this objective in mind Central Electricity Regulatory Commission (CERC) and State Electricity Regulatory Commissions were set up.

The Twelfth Five Year Plan laid special emphasis on development of infrastructure including Energy. The total infrastructure costs during Twelfth Five Year plan is estimated at 56.3 Lakh Crore (About US $1.00 Trillion). This could be feasible primarily enlarged private sector participation that is envisaged Public Private Partnership (PPP) and more transparent regulatory mechanisms that will induce Private investors to increase their participation the share of private sector participation increased from 22 per cent in 10th Plan to 38 per cent in the 11th Plan. and subsequently to 46.8 per cent by end of January 2020. The Per capita consumption of electricity in India is very low at 1121 KWh compared to other developed economies China 4,476 KWh, USA 12,073 Kwh, Japan 8072 Kwh.

2. Energy Resources in India:

Though the energy resources in India compared to other countries in South Asia is reasonably good, its rank in the world countries is still far from satisfactory. The following table shows the production capacities of power under different sectors in India. Under Public sector both state (28%) and central (25.2%) together 53.2% is the installed capacity of power produced in the public sector, where as private sector contributes 46.8%. The total installed capacity of power produced is 3,68,689 M.Watts in India as on January 2020. However annual peak electricity load is around 1,92,000 M.Watts (2019). which is lower than the installed capacity.

Table1: Total Installed capacity of Power in India (As on 31-01-2020)

Sector	M.Watt	Per Cent age
State Sector	1,03,285	28.0

Central Sector	92,890	25.2
Private Sector	1,,72,600	46.8
Total	**3,68,689**	**100**

The demand projection of India by the end of 2022 is almost domicile the present day capacity which requires much larger forces to implement the post the project in the pipeline as well as to attract a healthy investment in energy sector both in public and private sector. According to BW Smart Cities Report, India needs 900 G.Watts of total power generation capacity by 2025 to really fulfil the energy needs of the country.

Table 2: The power production according to different fuels (Jan 2020):

S. No	Fuel	G. Watts	Per Cent age
1	**Thermal (Coal, Gas & Oil)**	230.18	62.8
2	Hydro	45.39	12.4
3	Nuclear	6.78	1.9
4	Renewable Energy	86.32	22.9
Total		**368.69**	**100**

The power production accruing to different fuels is shown in table 2. Power production in the country is mostly thermal energy with 62.8 percent of the total installed capacity of which coal based fuel is 34.87 per cent, Oil 13.48 and Gas 7.75 per cent.

Next to thermal, hydropower constitutes 12.4 percent and 22.9 percent of renewable energy. Nuclear energy is just 1.9 per cent of the total energy produced.

3. Renewable Energy:

Renewable energy is important keeping in view the need for sustainability of power generation to ensure uninterrupted supply of Power 24 x 7 days in a week. In December 2018, the global renewable energy generation capacity amounted to 2,351 GWatts, Hydropower constituted around half the share of the global total energy capacity, with an installed capacity of 1,172 GW.

- India has the 4th largest wind power capacity in the world. In October 2018, wind power installed capacity stood at 34.9 GW.

- India has the 5th largest solar power capacity in the world. Solar Energy capacity increased to 24.3 GW in October 2018.
- The world's largest ground-based solar power plant is located in Kamuthi (Tamil Nadu, India) and the world's largest rooftop solar plant is located in Beas (Punjab, India).
- Biomass power includes installations from biomass combustion, biomass gasification and bagasse co-generation, for which capacity stands at 9.5 GW as of November 2018.
- Total renewable energy capacity stood at 86.32 GW (22.9%) apart from hydropower at 45.58 GW (13.1%).

3.1 Wind Power:

India has the fourth largest installed wind power capacity in the world. The development of wind power in India began in the 1990s in Tamil Nadu and significantly increased in the last decade. As of 31 March 2018, the installed capacity of wind power was 34.05 GW, spread across many states of India. The largest wind power generating state is Tamil Nadu, accounting for nearly 23% of installed capacity, followed in decreasing order by Gujarat, Maharashtra, Rajasthan and Karnataka.

3.2 Solar Energy:

India has planned harnessing solar energy potential in a big way. In December 2019, the installed capacity of Solar Power is 33.73 G.Watts. The cost of power generated by solar photovoltaics fell to ₹2.44 (3.4¢ US) per kWh in May 2017, lower than any other type of power generation in India. In the same year, the levelised tariff in US$ for solar electricity fell to 1.79 cents/kWh, far below the fuel cost for coal-based power plants in India. In 2020, the power tariff from Solar PV clubbed with pumped storage hydro or battery storage have fallen below the coal based power plant tariffs in offering base load and peak load power supply.

The **International Solar Alliance** (**ISA**): is an alliance of 121 countries initiated by India, most of them being **sunshine countries**, which lie either completely or partly between the Tropic of Cancer and the Tropic of Capricorn. Its head quarters is located at Gurugram, Haryana state in India. The primary objective of the alliance is to work for efficient exploitation of solar energy to reduce dependence on fossil fuels. This initiative was first proposed by Indian Prime Minister Narendra Modi in a speech in November 2015 at Wembley Stadium(U.K.), in which he referred to sunshine countries as *Suryaputra* ("Sons of the Sun"). The alliance is a treaty-based inter-governmental organization. Countries that do not fall within the

Tropics can join the alliance and enjoy all benefits as other members, with the exception of voting rights. . After the United Nations, it will be the largest grouping of countries world-wide.

The initiative was launched by Prime Minister Narendra Modi at the India Africa Summit, and a meeting of member countries ahead of the 2015 United Nations Climate Change Conference in Paris in November 2015. The framework agreement of the International Solar Alliance opened for signatures in Marrakech, Morocco in November 2016, and 200 countries have joined the Alliance..

3.3 Bio-Mass Energy:

The International Energy Agency (IEA) estimated that the percentage of bio mass energy within the total share is set to treble from 10 per cent at present to 30 per cent by 2050. In most of the developing economies, a poor bio mass resource governance results in the loss of bio mass energy resources. Bio mass energy resources are much cheaper and abundantly available, if properly the Bio-wastes are managed and will save a huge foreign exchange by way of reducing importing fuel either gas or coal. 'Bagasse' a waste from sugar cane, Municipal bio-degradable wastes and bio-diesel are major sources of Bio Mass energy resources. The Bio-mass energy installed capacity in India in 509.69 M.Watts.

3.4 Geothermal Energy:

Geo thermal energy exists in natural hot waste springs which can be harnessed:

The following are the sources of geo-thermal energies:

- Himalayan Province – Tertiary Orogenic belt with Tertiary magnetism
- Areas of Faulted blocks – Aravalli belt, Naga-Lushi, West coast regions and Son-Narma lineament.
- Volcanic arc – Andaman and Nicobar arc.
- Deep sedimentary basin of Tertiary age such as Cambay basin in Gujarat.
- Radioactive Province – Surajkund, Hazaribagh, Jharkhand. Cratonic province – Peninsular India

3.5 Hydro Power

India's potential for hydro power has been assessed to be about 125.57 G.Watts at 60% load factor. India is ranked fourth globally by underutilized hydro power potential. The estimated amount of viable hydro power varies with improved technology and the cost of electricity generation from other sources. In estimated 6,7Mof potential for small, mini, and micro-hydro generators, and 56 sites for pumped storage schemes with an aggregate installed capacity of 94,000 MW have been identified. In 2020, the power tariff from Solar PV clubbed with pumped storage hydro have fallen below the coal based power plant tariffs in **offering base load and peak load power supply.**

The installed hydro power capacity as of 31 March 2018 was approximately 45,293 MW, 13.17% of total installed utility capacity at the time.[3] Small, mini, and micro-hydro generators add another 4,486 MW capacity. The share of this sector operated by public companies is 97%. Companies engaged in the development of hydroelectric power in India include the National Hydroelectric Power Corporation (NHPC), Northeast Electric Power Company (NEEPCO), Satluj Jal Vidyut Nigam (SJVNL), Tehri Hydro Development Corporation, and NTPC-Hydro.

3.6 Hydrogen Energy

Hydrogen Energy program started in India after joining the IPHE (International Partnership for Hydrogen Economy) in the year 2003. There are nineteen other countries including Australia, USA, UK, Japan are members. This global partnership helps India to set up commercial use of Hydrogen gas as an energy source. A National Hydrogen Energy Road Map (NHERM) was prepared under the guideline of NHBE 2005 and was accepted by NHBE in 2006. This will implemented through Public Private Partnership.

4.Non-Renewable (Conventional) Energy:

4.1 Thermal Power

Thermal power plants convert energy rich fuel into electricity and heat. Possible fuels include coal, natural gas, petroleum products, agricultural waste and domestic trash / waste Coal and lignite accounted for about 57% of India's installed capacity. India expects that its projected rapid growth in electricity generation over the next couple of decades is expected to be largely met by thermal power plants.

Fuel constraints

A large part of Indian coal reserve is similar to Gondwana coal. It is of low calorific value and high ash content. The iron content is low in India's coal, and toxic trace element concentrations are negligible. The natural fuel value of Indian coal is poor. On average, the Indian power plants using India's coal supply consume about 0.7 kg of coal to generate a kWh, whereas United States thermal power plants consume about 0.45 kg of coal per kWh. This is because of the difference in the quality of the coal, as measured by the Gross Calorific Value (GCV). On average, Indian coal has a GCV of about 4500 Kcal/kg, whereas the quality elsewhere in the world is much better; for example, in Australia, the GCV is 6500 Kcal/kg approximately.

The high ash content in India's coal affects the thermal power plant's potential emissions. Therefore, India's Ministry of Environment & Forests has mandated the use of beneficiated coals whose ash content has been

reduced to 34% (or lower) in power plants in urban, ecologically sensitive and other critically polluted areas, and ecologically sensitive areas. Coal benefaction industry has rapidly grown in India, with current capacity topping 90 MT.

Thermal power plants can deploy a wide range of technologies. Some of the major technologies include:

- Steam cycle facilities (most commonly used for large utilities);
- Gas turbines (commonly used for moderate sized peaking facilities);
- Cogeneration and combined cycle facility (the combination of gas turbines or internal combustion engines with heat recovery systems); and
- Internal combustion engines (commonly used for small remote sites or stand-by power generation).

India has an extensive review process, one that includes environment impact assessment, prior to a thermal power plant being approved for construction and commissioning. The Ministry of Environment and Forests has published a technical guidance manual to help project proposers and to prevent environmental pollution in India from thermal power plants.[62]

Installed Thermal Power capacity

The installed capacity of Thermal Power in India, as of Jan,2020, was 230.18 G.Watts, which is 62.8 per cent of total installed capacity.

- Current installed base of Coal Based Thermal Power is 1,96,097 MW which comes to 58.75% of total installed base.
- Current installed base of Gas Based Thermal Power is 24,860. MW which is 9.% of total installed capacity.
- Current installed base of Diesel Based Thermal Power is 837.67 MW which is 0.5% of total installed capacity.

The state of Maharashtra is the largest producer of thermal power in the country.

4.2 Nuclear Power:

Nuclear power is the fifth-largest source of electricity in India after coal, gas, hydroelectricity and wind power. As of March 2018, India has 22 nuclear reactors in operation in 7 nuclear power plants, with a total installed capacity of 6,780 MW.[1][2] Nuclear power produced a total of 35 TWh and supplied 3.22% of Indian electricity in 2017.[3][4] 7 more reactors are under construction with a combined generation capacity of 4,300 MW.

4.3 Gas for Power Sector

The present Gas based power capacity in India stands at 24.86 G.W, which is about 10% of the total installed capacity. For running this capacity 66 mmscmd of gas is required, and about 40 mmscmd of gas has been allocated for the same. To make the situation worse the actual availability of gas is always less than the allocated quantity.

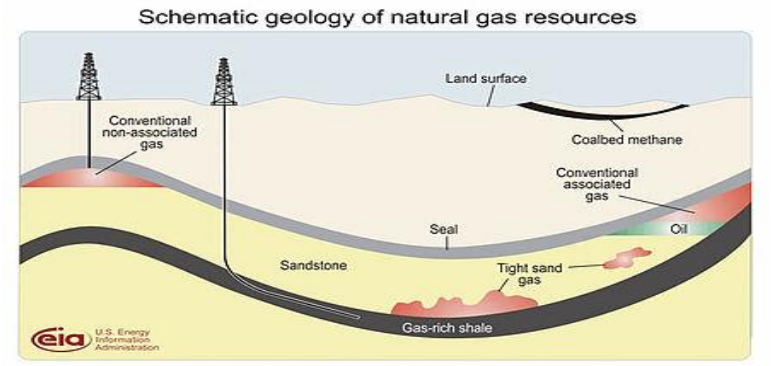
Some of the gas based power projects have been shelved while a few are pending commissioning due to unavailability of gas. The operational projects still run at sub optimal PLF due to gas shortage. It has been estimated that if the existing capacity could be run at 77% PLF, about 3500 million units of electricity per month could be added.

4.4 Shale gas

Natural gas that is found trapped within shale formations. Shale gas has become an increasingly important source of natural gas in the United States since the start of this century, and interest has spread to potential gas shales in the rest of the world. In 2000 shale gas provided only 1% of U.S. natural gas production; by 2010 it was over 20% and the U.S. government's Energy Information Administration predicts that by 2035, 46% of the United States' natural gas supply will come from shale gas.

Indian Reserves- Shale gas

India’s shale gas reserves are not comparable to the reserves of USA, Canada, and China which occupy the top 3 nations in the World having highest shade gas reserves.



Companies including Reliance Industries Limited (E&P), RNRL, Vikas WSP Limited have expressed interest in exploring in India, which is estimated to hold 63 trillion cubic feet of recoverable shale gas. Reliance Industries paid a reported US$1.7 billion for a 40% share in Atlas Energy's leasehold in the **Marcellus** shale gas play in the eastern US. A complication to shale gas in India is that the government-issued leases for conventional petroleum exploration do not include unconventional sources such as shale gas. India identified shade gas reserves in Cauvery basin in Gujarat, Assam basin and the Godavari basin.

During US President Obama's visit to India in November 2010, India and US decided to cooperate in the fields of clean-tech and shale gas. "We agreed to deepen our co-operation in pursuit of clean energy technologies, including the creation of a new clean energy research centre here in India, and continuing our joint research into solar, biofuels, shale gas and building efficiency," Obama said.

5. Problems of harvesting shale gas in India:

India's move for exploiting **shale gas** resources in the country has been red-flagged by The Energy and Research Institute (TERI) stating that in a water-stressed country like ours, rapidly approaching water scarcity conditions, the results might not be as dynamic as it had proved for the U.S.

The latest policy brief "Shale Gas in India: Look before You Leap" explores the question of shale gas being a game changer in the context of India. It explains the nature of shale gas, the technology for its extraction from underground sources, and its potential for India. It also highlights overseas acquisitions of this resource by Indian companies even before it is sourced domestically, and then examines the viability of the technology in India. One of the key determinants of the viability of this technology is the availability of large quantities of clean water. The policy brief points out that conventional gas can occur by itself or in

association with oil. Coal bed methane (CBM), which is extracted from coal beds, is also an unconventional gas and, in terms of depth, occurs much closer to the land surface than other similar gases.

However, shale rock is sometimes found 3,000 metres below the surface. Therefore, after deep vertical drilling, there are techniques to drill horizontally for considerable distances in various directions to extract the gas-rich shale. A mixture of water, chemicals, and sand is then injected into the well at very high pressures (8,000 psi) to create a number of fissures in the rock to release the gas. The process of using water for breaking up the rock is known as '**hydro-fracturing' or 'fracking'.** The chemicals help in water and gas flow and tiny particles of sand enter the fissures to keep them open and allow the gas to flow to the surface. This injection has to be done several times over the life of the well.

The number of wells to be drilled for shale gas far exceeds the number of wells required in the case of conventional gas and the land area required is a minimum of 80 to 160 acres.

7. Problems with India's power sector:

1. **Inadequate last mile connectivity**. The country already has adequate generation and transmission capacity to meet the full consumer demand, both temporally and spatially.[5] However, due to the lack of last-mile link-up between all electricity consumers and a reliable power supply (to exceed 99%), many consumers depend on diesel generators.[42] Nearly 80 billion kWh of electricity is generated annually in India by diesel generator sets that consume nearly 15 million tons of diesel oil. Over 10 million households use battery storage UPS as back-ups in case of load shedding.[202] India imports nearly US$2 billion worth of battery storage UPS every year.[203] As overhead lines cause distribution problems during rain and wind storms, there is a plan to lay buried cables from low voltage substations to supply cheaper emergency power in cities and towns and thus reduce diesel oil consumption by diesel generator sets and the installation of UPS systems.
2. **Demand build up measures**. Electricity-intensive industries consume the cheaper electricity (average price Rs 2.5 per kWhr) available from the grid instead of running their own coal/gas/oil fired captive power plants.[204][205] The captive power generation capacity by such plants is nearly 53,000 MW, and they are mainly established in steel, fertilizer, aluminum, cement, etc. industries.[206][5] These plants can draw cheaper electricity from the grid on short term open access (STOA) basis, avoiding their own higher cost of electricity generation and diverting power from other consumers.[207][208] Some of these idling captive power plants can be used for ancillary services or grid reserve service and earn extra revenue.

3. **Unequal electricity distribution**. Almost all households have access to electricity.[1] However, most households find the electricity supply intermittent and unreliable.[211] At the same time, many power stations are idling for lack of electricity demand and the idling generation capacity is sufficient to supply the needs of households lacking electricity three times over.
4. **Erratic power pricing**. In general, industrial and commercial consumers subsidize domestic and agricultural consumers. Government giveaways such as free electricity for farmers, created partly to curry political favor, have depleted the cash reserves of state-run electricity-distribution system and led to debts of ₹2.5 trillion (US$35 billion).[214] This has financially crippled the distribution network, and its ability to pay to purchase power in the absence of subsidies from state governments.[215] This situation has been worsened by state government departments that do not pay their electricity bills.
5. **Over-rated capacity**. Many coal-fired plants are overrated above the actual maximum continuous rating (MCR) capacity.[216] to allow the plant cost to be inflated.[217] These plants operate 15 to 10% below their declared capacity on a daily basis and rarely operate at declared capacity, undermining grid stability.
6. **Lack of timely information on load and demand**. Intraday graphs at 15-minute or more frequent intervals are required to understand the shortcomings of the power grid with respect to grid frequency, including comprehensive data collected from SCADA for all grid-connected generating stations (≥ 100 KW) and load data from all substations.
7. **Lack of adequate coal supply**: Despite abundant reserves of coal, power plants are frequently under-supplied. India's monopoly coal producer, state-controlled Coal India, is constrained by primitive mining techniques and is rife with theft and corruption.[*citation needed*] Poor coal transport infrastructure has worsened these problems. Most of India's coal lies under protected forests or designated tribal lands and efforts to mine additional deposits have been resisted.
8. **Poor gas pipeline connectivity and infrastructure**. India has abundant coal bed methane and natural gas potential. However a giant new offshore natural gas field has delivered far less gas than claimed, causing a shortage of natural gas.
9. **Transmission, distribution and consumer-level losses**. Losses exceed 30%, including the auxiliary power consumption of thermal power stations and fictitious electricity generation by wind generators, solar power plants & independent power producers (IPPs), etc.
10. **Resistance to energy efficiency in the residential building sector**. Continuous urbanization and the growth of population result in increased power consumption in buildings. The belief still

predominates among stakeholders that energy-efficient buildings are more expensive than conventional buildings, adversely affecting the "greening" of the building sector.

11. **Resistance to hydroelectric power projects**. Hydroelectric power projects in India's mountainous north and northeast regions have been slowed down by ecological, environmental and rehabilitation controversies, coupled with public interest litigation.
12. **Resistance to nuclear power generation**. Political activism since the Fukushima disaster has reduced progress in this sector. The track record of executing nuclear power plants is also extremely poor in India.
13. **Theft of power.** The financial loss due to theft of electricity is estimated at around $16 billion yearly.

Key implementation challenges for India's electricity sector include efficient performance of new project management and execution, ensuring availability and appropriate quality of fuel, developing the large coal and natural gas resources available in India, land acquisition, obtaining environmental clearances at state and central government level, and training skilled manpower.

8. Captive Power Generation:

A **captive power plant**, also called **auto-producer** or **embedded generation**, is an electricity generation facility used and managed by an industrial or commercial energy user for their own energy consumption. Captive power plants can operate off-grid or they can be connected to the electric grid to exchange excess generation.

Captive power plants are generally used by power-intensive industries where continuity and quality of energy supply are crucial, such as aluminum smelters, steel plants, chemical plants, etc. However, the radical cost declines for solar power systems have enabled the opportunity for less energy intensive industries to economically grid defect by coupling solar PV with generators or cogeneration units along with battery systems.

9. New Tariff Policy:

There exists considerable in the average tariff rate of electricity supply to domestic and industrial consumers. Under the provisions of the Electricity Act, 2003, Central Government has notified the tariff policy, evolved in consultation with the State governments, CERC and various stakeholders. To promote competition, the policy provides that all future requirements of power should be procured competitively, except in the case of one-time expansion of existing projects, or where a state-controlled publicly owned

company has been identified as the developer. A transmission period of five years has been indicated for achieving the goal of developing generation and transmission projects in the public sector also through competitive bidding only. The policy lays down a time frame for rationalization of electricity tariffs and mandates reduction of the cross subsides to within a band of ± 20 percent by the end of year 2010-11. The policy clearly states that provision of free electricity and, in most of the cases, depletion of the wasteful consumption of electricity is not desirable, as it through open-access in distribution, the policy provides methodology for calculating cross-subsidy surcharge and its time bound reduction. It also lays down the mechanism for arranging back-up supply for such consumers.

10.Power Transmission Network and National Power Grid:

Transmission of electricity is defined as bulk transfer of power over a long distance at a high voltage, generally of 132 kv and above. The entire country is divided into 5 regions for transmission systems, namely Northern Region, North-Eastern Region, Eastern Region, Southern Region and Western Region. The interconnected transmission systems within each region is called the regional grid.

11. Initiative to Attract Private Investments:

The present policy of the Government seeks to attract significant private sector investments in the Indian power sector. The key initiatives in this regard are the following :

1. Private sector has been permitted to set up coal, gas or liquid-based thermal projects, hydro projects and wind or solar projects of any size.
2. Foreign equity participation has been brought under automatic approval route for generation, transmission and distribution of power generation in hydroelectric, oil-based and coal/lignite-based power projects.
3. Role of the Central Government has been curtained and the State Governments and State Electricity Boards (SEBs) have been empowered to negotiate directly with developers, facilitating speedy clearances for the investors.
4. Ancillary sector such as coal has been significantly deregulated. 100 percent foreign equity is permitted.
5. State Governments have agreed to allow the gradual entry of the private sector in distribution.

12. Funding of power infrastructure

Borrowings by state owned discoms & commercial losses of discoms

India's Ministry of Power administers the Rural Electrification Corporation Limited and the Power Finance Corporation Limited. These central-government-owned public sector enterprises provide loans and guarantees for public and private electricity sector infrastructure projects in India. Excessive plant construction loans at 75% of overestimated costs on overrated plant capacities have

led to stranded assets of US $40 to 60 billion. The central and state-owned power generators escaped this crisis as they had entered PPAs with state-owned monopolistic discoms on a cost-plus basis at higher than prevailing market power tariffs, without undergoing competitive bidding process. Many direct and indirect subsidies are given to various power generators.

13. FDI in the Power Sector:

The Government announced significant new policy initiatives to attract foreign investment in this sector. In explanation and production sharing contracts. Foreign investment in it was permitted up to 100 percent in small-sized oil fields: 60 percent for unincorporated joint ventures and 51 percent for incorporated joint ventures; and 100 percent for exploitation and production of blocks identified under the new Exploration Licensing Policy.

The level of FDI in oil reforming sector under automatic approval has been raised from 49 percent to 100 percent. For gas fields developed in the private sector, promoters are free to market the gas at market-related prices.

FDI is permitted up to 74 per cent in infrastructure related to marketing of petroleum products. As per the new policy, foreign investors can enter into a joint venture with an Indian partner for financial and/or technical collaboration and also for setting up of renewable energy based power generating projects. The liberalized foreign investment approval regime aims at facilitating foreign investment and transfer of technology through joint ventures. Government of India is encouraging foreign investors to set up renewable energy based power generation project on build own-operate basis.

Way Forward:

- Enhance the generation of Renewable energy, Solar Power, indigenous manufacturing of solar panels
- Promote the use of Solar pump sets for agriculture. Local Discoms should buy surplus power from the farmer.
- Enhance the production of oil, gas from the existing fields of ONGC using cutting edge technology through a frame work production enhancement contracts.
- Widen the Perform, achieve and Trade (PAT) programme, make energy Servicing Certificate (ESC) trading under the PAT scheme effectively by ensuring strict penalties against defaulters.
- The Bureau of Energy Efficiency (BEE) should come out with a white paper on its 5 -year strategy on energy efficiency in various sectors and specify energy consumption norms. .

14. UDAY Scheme:

Ujjwal DISCOM Assurance Yojana (UDAY) is the financial turnaround and revival package for electricity distribution companies of India (DISCOMs) initiated by the Government of India with the intent to find a permanent solution to the financial mess that the power distribution is in. It allows state governments, which own the DISCOMs, to take over 75 percent of their debt as of September 30, 2015, and pay back lenders by selling bonds. DISCOMs are expected to issue bonds for the remaining 25 percent of their debt.

15. UJALA Scheme

Launched in 2015, the **Unnat Jyoti by Affordable LEDs for All (UJALA),** has emerged as the world's largest domestic lighting programme. Developed to address India's high cost of electrification and high emissions from inefficient lighting, UJALA's success lies in its inimitable strategic approach to energy efficiency.

Globally, India is at a vantage point of mitigating climate change, while also building and strengthening its access to energy and lighting. While high-quality energy efficient appliances meet both these criteria, India was held back from adopting them due to lack of awareness and affordability. Taking these challenges head on, EESL adopted a strategy of demand aggregation, mass awareness and bulk procurement, designed to attract the support of utility companies, state governments, and the price conscious Indian public.

Going forward, the company aims to distribute 77 crore LEDs by March 2019 across 100 cities. The UJALA scheme will thus, make an enormous impact by securing: annual energy savings of 10,000 crore kWh, 79 crore tonnes of reduction in CO2 emissions per year and avoid capacity generation of nearly 20,000 MW.

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Mains Questions:

1. Access to affordable, reliable, sustainable and modern energy is the *sine qua non* to achieve Sustainable Development Goals (SDGs)".Comment on the progress made in India in this regard. (UPSC 2018)
2. Indian Infrastructure is woefully inadequate, which is a major impediment in its growth path to compete with China and USA , even though it has the potential. Is the present policies and budget provisions are adequate to achieve the Government's objective to become a $5 Trillion economy by 2025?.
3. Uninterrupted Power Supply to Indian Industry, Services and Agriculture will attract more investments and thereby increase economic growth. Analyse the above statements with facts and figures and substantiate.
4. India requires around 1627 Bn. Units of Power by 2025. Is it possible with the present pace of its development strategies, whether India can achieve the targeted power by 2025? If not what should India do?
5. Critically examine the Indian Power Sector and suggest ways to improve the energy production in India.
6. The percentage of renewable energies in India's Power sector is just 22 per cent of total power generated. As per Paris agreement, 40 per cent of energy sources from non-fossil fuels i.e. essentially from renewable energy sources. What hinders the India's planning bodies as well as its implementers to attain self sustenance in the clean energy sector? .

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