Yojana - Harnessing Sustainable Energy

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Climate Change: Challenges and Opportunities

- According to the forecast of IMD average temperatures in most parts of the country are likely to be 0.5°C higher than normal.
- Annual temperature in India between 1901 and 2017 has shown a significant increasing trend (0.66°C per hundred years). Global average temperature is now 1°C above pre industrial levels.
- **IPCC special report**, Global Warming at 1.5°C concluded that the world was on a path to temperature increase of 1.5°C in twelve years i.e. by 2040.
- South Asia, particularly **India is a hotspot** and will be exposed to multiple and overlapping hazards as the planet warms.

Highlights of India's Climate Action

- In 2008, India launched the **National Action Plan on Climate Change** with eight missions. Besides, a national level plan, 32 states and union territories have prepared state level climate action plans.
- **Emission intensity** of India's GDP has **reduced by 21%** over the period of 2005-2014.
- The share of non-fossil sources in installed capacity of electricity generation increased from 30.5% in 2015 to 35.5% in 2018.
- India is partnering 22 member countries and the EU in the '**Mission Innovation'** on clean energy.
- India in partnership with France launched **International Solar Alliance** at the UN Climate Summit in Paris 2015.
- **PAT Scheme** for energy efficiency has been rolled out.

According to **Global Resources Outlook 2019**, by the International Resource Panel, a United Nations Environment – sponsored science body, global extraction and processing of material resources contribute to more than 50% of the greenhouse gas emissions.

- The climate change poses a complex challenge for an emerging economy such as India. India cannot afford to adopt the growth models that have underpinned the rise of developed industrialized economies and developing economies such as China.
- India will need to **transition to production and consumption systems that are sustainable**, produce less waste and use resources and products more efficiently and in a manner that they can be reused, remanufactured, recycled or recovered.
- India will require investing in human capital, innovation and research and development. It must invest in innovations that **minimize the social cost of a climate-induced transformation** of the economy.

India's Conundrum: Aligning Emission Mitigation with Development

In recent years, share of OECD and non-OCED emission has reversed i.e.

	OCED	Non-OCED
1960	61%	39%
2017	37%	63%

- India and China accounted for 55percent of non-OCED emissions, with China contributing to 44% and India for 11% in 2017.
- India's GHG emissions have increased by nearly 115% between 1994 and 2014.

India's Energy Transition

- In the initial years of national planning following India's independence the primary focus was on **socio-economic development** and energy policies focused on **supply adequacy** and **infrastructure development.**
- Energy sector witnessed a gradual transition away from traditional use of biomass to **modern energy forms** like coal and petroleum products.
- 5-Year Plans shifted focus from issues of energy access in the 1970s to that of **national energy security** in the 1980s and **modernization of energy infrastructure** in the 1990s.
- During these years, the energy sector witnessed a transition towards **higher levels of electrification** and an increase in the share of **thermal power generation.**
- Increasingly the understanding of energy security also evolved to include aspects of **access, affordability and efficiency**.
- **11th & 12th FYP** presented the broad vision and aspiration of a faster, sustainable and more inclusive growth. Priority to **environmental sustainability** was also explicitly mentioned.

Most countries in the past have undertaken a **decoupling of emissions** from their growth trajectory at a time when the requirement for rapid growth and industrialization was already over. This places India in a unique position where there is a need to think about the transitions in the coming years.

According to the **Global Carbon Project**, emissions in India were estimated to have grown by 6.3% in 2018, pushed by strong annual economic growth. India was among the four major emitters in 2017 (7%) along with China (27%), US (15%) and EU (10%).

- **Energy sector** accounts for **73%** of India's total emissions.
- **Coal** still is the mainstay of Indian economy. Nearly **65%** of India's electricity is generated from thermal power.
- The other major energy source is '**oil**'. Road transport sector accounts for 6.7% of India's GDP. **Diesel** alone meets an estimated **72%** of transportation fuel demand.
- Another major source of pollution is nuclear power generation. Nuclear power plants create 50% more thermal pollution than fossil fuel plants.

The challenge India faces now is to **improve energy access** to modern energy at **affordable price** in a sustainable and responsible manner without sacrificing economic and social developmental needs.

Ocean Energy

Oceans are an inexhaustible source of renewable energy. Ocean energy is the energy harnessed from ocean waves, tidal range & tidal streams, temperature gradients and salinity gradients.

Leading countries in Ocean Energy technology are UK, USA, Sweden, Canada France, South Korea etc.

Tidal Energy – Difference in water level from low tide and high tide is potential energy that can be harnessed. Potential for tidal energy in India is 12500MW. Promising locations are Gulf of Khambhat & Gulf of Kutch, Western Ghats etc.

Problems – The capital cost for tidal energy power plants is very high due to high civil construction that results in high power tariffs.

Wave Energy – Wave energy is generated by the movement of a device either floating on the surface of the ocean or moored to the ocean floor by the force generated by the ocean waves. Potential for wave energy in India is 41000MW. Promising locations are western coasts of Maharashtra, Goa, Karnataka, Kerala etc.

These technologies are more suitable for **off-grid electricity generation**. Major bottlenecks for deployment are **high upfront cost**. Most ocean technologies are at pre R&D/commercialization stage worldwide. Therefore they need validation from leading research institutes before demonstration.

Geo-Thermal Energy

Geothermal energy is a mature renewable energy technology that can be utilized for both electric power production and direct heat application. It has experienced modest growth worldwide in recent times as compared to other RE sources.

India is still at nascent stage of geothermal energy utilization with no geothermal power plant setup in the country so far.

Major Limitations-

- Site Specific Nature
- Risk/Uncertainty involved with resource exploration
- High Capital cost

Total installed capacity for geothermal power is around 13.5 GW around the world. Leading countries in geothermal power generation capacity are USA, Indonesia, Japan, New zeland, Mexico, Turkey. As per Geological Survey of India, there are around 300 geothermal springs in India. Most of them are of medium and low potential.

Promising sites for electricity generation using geothermal energy are;

- **Puga Valley & Chummathang** in J&K
- **Cambay** in Gujarat
- **Tattapani** in Chattisgarh
- **Khammam** in Telangana
- **Ratnagiri** in Maharashtra

Promising sites for direct heat use using geothermal energy are;

- **Rajgir** in Bihar
- **Manikaran** in Himachal Pradesh
- **Surajkund** in Jharkhand
- **Tapoban** in Uttrakhand
- **Sohana** Region in Haryana

Biogas

India generates about 53 million tonne of waste annually and on an average 46% of it is processed.

Bio-gas is produced naturally through a process of **anaerobic decomposition** from waste / bio-mass sources. 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. With calorific value and other properties similar to

CNG, Compressed Bio-Gas can be used as an **alternative, renewable automotive fuel**. Given the abundance of biomass in the country, Compressed Bio-Gas has the **potential to replace CNG** in automotive, industrial and commercial uses in the coming years.

CBG can be produced from various biomass/waste **sources**, including agricultural residue, sugarcane press mud, distillery spent wash, cattle dung and sewage treatment plant waste.

Estimated potential of CBG – 62million tonne annually.

Benefits:

- Responsible waste management
- Reduction in carbon emissions and pollution
- Additional revenue source for farmers
- Boost to entrepreneurship, rural economy and employment
- Support to national commitments in achieving climate change goals
- Reduction in import of natural gas and crude oil
- Buffer against crude oil/gas price fluctuations

Compressed Bio-Gas networks can also be **integrated with city gas distribution (CGD) networks** to boost supplies to domestic and retail users in existing and upcoming markets.

Measures Taken by Government:

- The **National Policy on Biofuels 2018** emphasizes active promotion of advanced bio-fuels, including CBG.
- The Government of India had launched the **GOBAR-DHAN** (Galvanising Organic Bio-Agro Resources) to convert cattle dung and solid waste in farms to CBG and compost.
- **SATAT**, initiative is aimed at providing a **Sustainable Alternative Towards Affordable Transportation** as a developmental effort that would benefit both vehicle-users as well as farmers and entrepreneurs. This initiative holds great promise for efficient municipal solid waste management and in tackling the problem of polluted urban air due to farm stubble-burning and carbon emissions.

A sewage treatment plant launched in Delhi would convert 10 lakh litres of sewage into three tonnes of biofuel per day.

Electric Mobility

With global penetration growing at close to 75% per year, electric mobility is the definitive game changer for the transport sector the world over. India (is a member of Clean Energy Ministerial: a high-level forum to promote clean energy policies and programmes) aims to achieve a 30% electric vehicle penetration by 2030.

Why Electric Mobility?

- According to NGT, vehicular emission is one of the major sources of India's urban pollution.
- By 2030, India is anticipated to have an estimated 400 million customers in need of mobility.
- According to a Niti Ayog report – India can reduce 64% of the energy demand for road transport and 37% of carbon emissions by 2030 by pursuing a shared, electric and connected mobility future.
- Even powered by the most carbon-intensive electricity, EVs still have lower GHG emission than a conventional, internal combustion engine powered vehicle.

Recent Measures Taken

- **National Mission on Transformative Mobility and Battery Storage** – It encourages setting up large scale, export-competitive integrated batteries and cell-manufacturing giga-plants in India through a Phased Manufacturing Programme (PMP). The Mission's focus on productive localization can bring down the battery storage costs.
- **Solar Powered Public Charging Stations –** They are being rolled out across India by discoms like BHEL, delivering 100% zero-emissions based electricity to electric vehicles.

Steps to Achieve India's Solar Potential

India's current per capita consumption of electricity stands at a meagre 1100kWh/year which is much lower compared to other large economies like the US & China. Demand for power is set to rise with increasing urbanization and industrialization.

In the past years we have already added 28GW solar capacity. Launch of **ISA** (International Solar Alliance), setting up of **solar parks**, providing **VGF** and introducing schemes like **KUSUM** (aiming to harness solar power for agriculture) and **SRISTI** (catalyzing adoption of rooftop solar solutions) has shown government's keenness to fast track the growth of solar industry.

However, room for more strategic interventions to fully realize India's potential is needed to help us move closer to the ambitious target of 100GW solar power capacity by 2022. Five areas that need more attention an focus are;

- **Technology** – Newer advancements in the field like floating solar (solar panels mounted on structures that float on water bodies), and BIPV (wherein conventional materials used for facades and roofs of buildings are replaced by photovoltaic systems)
- **Policy Push** – Tariff margins discovered in reverse auctions have been pushed lower in recent years leading to a squeeze in profit margins. State governments should accentuate the rate of solar power generation with regular capacity addition. They must also push for rooftop solar solutions.
- **Discom Health** – Discoms are a crucial link in the cycle of energy generation. Steps must be taken to support higher tariffs, honor RPOs and settle power providers' due on time.

Government should also bring in a policy to operationalize ancillary and capacity markets to extract the total value of renewable energy technologies.

- **Financial Reforms** – Reforms in banking systems along with sectoral classification of renewables i.e. distinct from power sector would widen access to funds. Also, there is need for deeper and diverse bond markets.
- **Enabling Ease of Doing Business** - Faster processing of approvals for project implementation across the value chain, especially conversion approvals of land in different states would be of great help to the renewable sector.

Energy Efficiency

In India, the electrification of households has taken place on a massive scale and demand for energy has increased. Also, there has been enormous increase in energy intensive economic activities. As the conventional sources of energy are reducing and the renewable sources are under developing phase, improving energy efficiency at all levels of the energy spectrum is the cost-effective and quick solution to address this problem

Therefore, there is a need for a **concerted move to ensure increased energy efficiency** especially in **3 sectors**-

Industrial Sector

- Highest energy consuming domain.
- Potential for energy conservation and technology enhancement.
- PAT (Perform, Achieve and Trade) Scheme.

Real Estate

It consumers over 30% of total electricity consumption.

It is second only to the industrial sector as the largest emitter of greenhouse gases.

BEE (Bureau of Energy Efficiency) has two progams: **Eco Samhita** - To set minimum building envelope performance standards to limit heat gains and loss. **Labelling Progamme for Energy Efficient Homes** - To enable consumers to compare building performances from a sustainable energy point of view.

Consumer Appliance

Includes all daily household electronic appliances.

BEE has been promoting energy conservation through optimum temperature settings for ACs and advancement of technology in Microwave Ovens.

PAT Scheme

It is a **regulatory instrument** to **reduce specific energy consumption** in energy intensive industries, with an associated **market based mechanism** to enhance the cost effectiveness through **certification of excess energy saving** which can be **traded**.

The **design of the building envelope** will have a direct impact on: Heat conduction through the roof, opaque wall and glazed windows, Solar radiation gains, Natural ventilation, Day-lighting.

Whereas, **Energy labels** help consumers to make efficient decisions through the provision of direct, reliable and cost less information.

Added Benefits:

1. It shall act as an embryo to stimulate the larger energy-efficient materials and technologies market.
2. Housing value chain would encourage an additional set of professionals to ensure residential label granting.
3. Labelling mechanism shall cause a reduction in energy bills.
4. Fulfilment of Global Sustainable Development Goals 7 of the United Nations: Affordable and Clean Energy.

Financing Renewables in India

Over the period, renewable energy has emerged as a true **multi-benefit system**, combining ecological necessities with domestic priorities and economic opportunities. It addresses the complex challenges of energy security, energy access, growing energy demand and domestic job creation. The policy landscape for renewable energy deployment is ever evolving in response to felt needs.

Steps Taken by Government to support the renewable energy sector;

- **Fiscal and promotional incentives** such as capital subsidy
- Guidelines for **transparent competitive bidding process**
- Waiver of **inter-state transmission system** (ISTS) charges and losses
- **Viability gap funding** (VGF)
- **Standards for deployment** of renewables systems and devices
- Permitting **FDI up to 100%** under automatic route
- **Priority sector lending status** for renewable energy

Present status of source of finances of renewable energy sector in India;

- India has become a favorable investment destination for renewables in recent years.
- According to a report from CEEW, the **percentage of FDI in renewables has almost doubled**. India received about $3.2 billion in form of FDI in recent years.
- In addition to registered companies, venture capital and private equity investors contribute to equity investments.
- **Development banks** like IREDA, represent a key source of funds for renewables.
- **Grants and concessional finance** both play a role in stimulating renewable energy investment, although their share is miniscule in total finance space in India.

Broad estimates suggest that on annualized basis, investment opportunity for over US $30 billion per year is expected to come up for the next decade and beyond in renewable energy sector in India. In this context, arranging institutional finance for increased renewables deployment would require concerted efforts. The major areas for action are as follows;

- **Pension or Sovereign Funds** – These are potent sources for patient capital for renewables. Top 400 Global funds manage assets of around US $ 75 trillion.
- **Reducing the Cost of Foreign Debt** – This can be done by reducing the currency hedging cost to mobilize foreign capital and spur investment.
- **Robust Payment Security Mechanism (PSM)** – This will contribute to de-risking the investment. The timeliness and reliability of payments for power purchase by state distribution companies remains a persistent risk for investments. As a model, Rewa Solar project can be studied and replicated elsewhere.
- **Dedicated Ecosystem** – It can be plugged in most of the bilateral and multilateral financing institutions. Banks may also consider to earmark a certain percentage of their loan portfolio for renewables.

Forests and Water-Conservation and Sustainable Development

Streams, rivers and floodplains are among the most dynamic ecosystems on Earth.

- Nearly 70% of the world is covered by water, about 2.5% of it is freshwater and less than 1 % of the freshwater is actually accessible.
- India is home to one-sixth of the world's total population but has only 4% of the water resources.
- Two billion of world's population is going through water stress.

Forests, Water and People – Interconnectionsp

- Forests tracts constitute **catchment of rivers** and their tributaries. They also often **harbor their headwaters**.
- Forests absorb rainfall and snow melt, slow runoff, reduce soil erosion, improve water infiltration rates, recharge aquifers, thus exhibiting '**sponge effect'**.
- Forests along the stream **filter pollutants** from entering the water.
- Forests are **key determinants of climate** at global, regional and local levels.
- They play a critical role in the well being and functioning of the **hydrological cycle.**

Forests Management

- Management of Indian forests commenced way back in 1860s with the establishment of forest reserves, law enforcement and initiation of **silviculture-based forest working**.
- **Article 48A** provides clear mandate of the state to protect the environment.
- Forests and the protection of wildlife fall within the concurrent list.
- The **Environment (Protection) Act, 1986,** is the umbrella legislation for the protection of all aspects of the environment.
- The **Indian Forest Act, 1927** and the **Forest (conservation) Act, 1980** are the primary legislations governing forests.
- **Wildlife (Protection) Act, 1972** and the **Biological Diversity Act, 2002** are significant from the perspective of biodiversity, intellectual property right and access and benefit sharing.

Water Conservation

- **Regulation and development** of inter-state rivers falls within the legislative competence of the **union government**.
- **States** have the legislative competence over **water supplies, irrigation and canals**, **drainage and water storage**. States also have power over issues relating to land and land use.
- The issue of pollution and water quality falls primarily under the **Water (Prevention and control of pollution) Act, 1974.**

Water management will not be sustainable unless key ecosystem services that influence availability of water are explicitly considered from the landscape sustainability perspective.

