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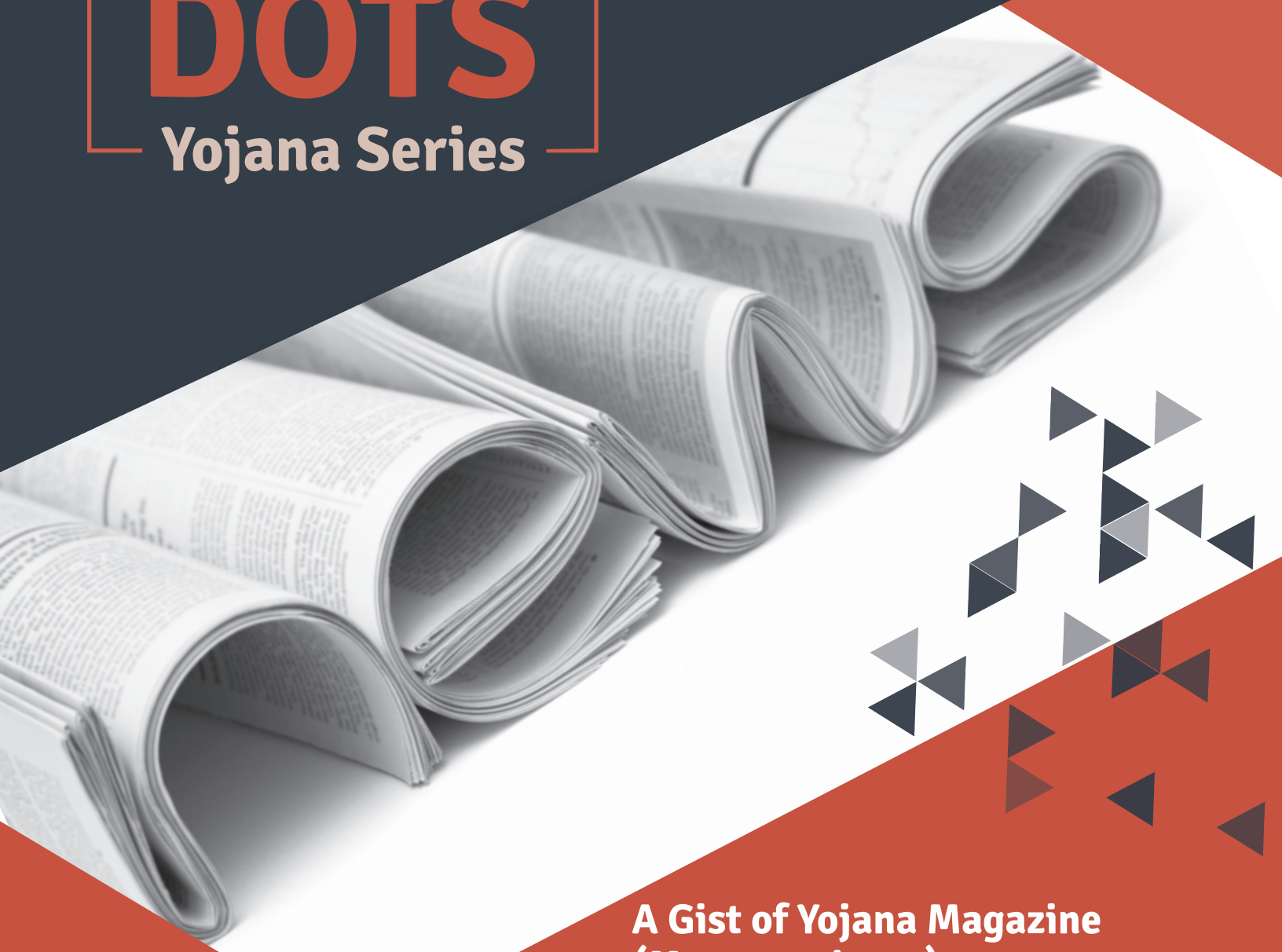

A Gist of Yojana Magazine (May 2019 issue)

Energy Efficiency is the Key for Sustainable Development

Driving a Green Transition for the Environment

The Future of Global Energy Security: India's Energy Needs

Geo-Thermal and Ocean Energy Technologies

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INQUIZITIVE MINDS

Contents

Join the dots! Yojna Synopsis
May 2019

Harnessing Sustainable Energy

Energy efficiency is the key for sustainable development

- There is direct relation between energy, environment and sustainable development
- National determined contribution has aimed to reduce emission intensity of GDP to 33-35 per cent below what it was in 2005 by 2030

To achieve the target there is a need for concerted move to ensure increased energy efficiency especially in 3 sectors

1. Industrial sector
2. Real estate
3. Consumer appliances

Industrial Sector

- Bureau of Energy Efficiency Is implementing Performance, Achieve and Trade (PAT) scheme under the National Mission on Enhanced Energy
- The PAT scheme is a market-based mechanism for large energy-intensive industries to improve energy efficiency. Under the scheme, three-year energy consumption targets are set for large industrial sectors.
- Industry units which consume lesser energy than their respective targets can sell energy saving certificates (ESCerts) to manufacturing plants which failed to do so.
- One ESCert is equivalent to one metric tonne of oil equivalent (Mtoe). Currently about 620 entities are engaged in ESCert trading.

Real Estate Sector

- Real estate sector consumes over 30 per cent of total electricity consumption in India annually and is second only to industrial sector as largest emitter of greenhouse gases.

BEE has two programs:

(I) Eco Samhita, Energy Conservation Building Code for Residential Buildings:

- Eco-Niwas Samhita (Part I: Building Envelope) aims to set minimum building envelope performance standards to limit heat gains (for cooling dominated climates) and to limit heat loss (for heating dominated climate with adequate natural ventilation and daylighting).

(II) Labelling for Energy Efficient Homes:

- To enable consumers to compare building performances from a sustainable energy point of view, a comprehensive labelling scheme is important. It is expected to save substantial energy through improving energy efficiency for houses nationwide. Shall act as an embryo to stimulate larger energy efficient materials and technologies market

Housing value chain would encourage an additional set of professionals to expedite complete process of residential label granting.

- It will motivate material manufactures to invest in energy efficient material manufacturing in India.
- Labelling mechanism shall cause a reduction in energy bills.
- It helps nation in working toward fulfilment of Global Sustainable Development Goals 7 of United Nations: Affordable and Clean Energy.

Consumer Appliances

- Daily household electronic appliances like AC, Microwave, Washing machine etc.
- According to study of BEE, one degree increase in AC temperature showcases results in saving of 6 per cent of electricity consumed.

- 24 - 26 degree Celsius default setting has been recommended by BEE for saving energy and for reduction in greenhouse gas emission.

Driving a Green Transition for the Environment

- **India has its own vision for electric mobility:** as a member of eight- country Clean Energy Ministerial, a high level forum to promote clean energy policies and programmes, India aims to achieve a 30 per cent electric vehicle penetration by 2030.
- According to National Green Tribunal (NGT), vehicular emission is one of major sources of India's urban pollution. Electric vehicles have zero tail pipe emissions, simply because they do not use an internal combustion engine (ICE). India can reduce 64 per cent of energydemand for road transport and 37 per cent of carbon emissions by 2030, by pursuing a shared, electric and connected mobility future.

Electric vehicles (EVs): Challenges and Way ahead

- Acknowledging the challenge of rising vehicular pollution in Indian cities, Piyush Goyal, then Union Minister for Power, said that from 2030, India would completely shift to using electric vehicles (EVs).
- The push for electric mobility was backed by the government think-tank, NITI Aayog, which has estimated that the nation can save up to Rs. 4 lakh crore by rapidly adopting EVs.

Benefits:

- While transitioning from an internal combustion engine (ICE)-based regime to an EV-based one is challenging, the long-term benefits could outweigh the hardships significantly in the wake of India's ambitious renewable energy plans.
- Jobs and the economic impact- India is the world's fourth largest fifth auto market, where over 25 million motor vehicles are produced. The sector is estimated to provide direct and indirect employment to about three crore people and accounts for 7.1% of the nation's GDP.
- The assumption that anyone who controls the battery will control electric mobility is true in the current scenario.
- India does not produce lithium-ion (Li-ion) batteries currently, and companies making battery packs are dependent almost exclusively on imports from China. This is a cost-saving strategy as setting up a cell manufacturing unit in India would be expensive.

Steps needed to be taken to boost electric mobility

- Accelerating EV use in India should be linked to the "Make in India" goal and domestic battery production.
- Investment is required for research and development in battery-making and exploring alternative technologies.
- EV charging is more than just using electricity. It involves exchange of information requiring a communication protocol. There is no unique or single-charging technology for EVs.
- The three major EV users, China, Japan and the European Union, have their own charging technologies which are often conflicting and not interchangeable. The absence of a standard global infrastructure is a major deterrent for EV penetration in India, as creating infrastructure can be cost-intensive.
- For this, the government needs to select or develop appropriate charging technology that avoids multiplicity and reduces the cost of infrastructure, while making it convenient and safe for users.

The Future of Global Energy Security India's Energy Needs

- A mutually supportive relationship between producers and consumers
- Optimal use of the neutral platform of the IEF to build a global consensus on 'responsible pricing', that serves the mutual interests of both producers and consumers Said
- Country's refineries are on track to meet the ambitious target to produce clean and affordable fuel by April 2020
- India's energy consumption will grow 4.5 percent every year for the next 25 years. There is a need for a more transparent and flexible market for the oil and gas sectors. India imports 80 percent of its oil needs and is the third largest oil consumer in the entire world.
- The efforts at artificially distorting oil prices were self-destructing and affected developing countries like India. Thus, it is in the interest of oil producers that consuming markets grow.

Steps to be taken

- India needs to establish an integrated planning process that factors in the implications of decisions concerning fossil fuels on renewables and vice versa, and develop a policy mind-set that enables the fulfilment of short-term objectives without compromising longer term goals.
- Correct the imbalances in the energy value chain, to minimize avoidable losses and create a unified energy market.
- Redesign and restructure the institutions of energy governance to enable and facilitate holistic energy planning and an integrated energy market.
- As a first step in that direction, the government should consider legislating an omnibus "energy responsibility and security act".
- This will raise public awareness on the interconnections between the various components of energy and between energy and the rest of the economy.
- Cities are the reasons for surging energy demand and air pollution. The government should devolve the energy administration of cities to an autonomous and constitutionally safeguarded "city energy ombudsman".
- These ombudsmen should be empowered to tackle issues related to energy efficiency, demand conservation, waste management, urban redesign and transportation and to develop and implement focused, small-scale and distributed solutions.
- There is a need to invest in supportive infrastructure, regulations, skills and innovation.While CNG buses have been introduced in various cities, the only way for a totally emissions-free public transport is by going all electric.
- Energy security would mean our ability to manufacture the full value chain in solar panels far more than getting access to equity oil or gas anywhere in the world. The sooner we match China's capacities in producing solar panels and storage batteries for electric cars, we will be better placed in handling our energy security in the years to come.
- Niti Aayog must carry out a detailed study on what will be required to shift from the incumbent fossil fuel energy system to a "clean energy" system.

Steps to be taken to boost energy drive

- Today, every projection of India's energy future draws the same broad conclusion: energy demand will move on an upward curve, indigenous supplies will fail to keep pace, energy imports will rise, and the environment will face increasing stress.
- More specifically, coal will dominate, oil and gas will have significance; renewables, whilst on a rising trend, will account for a relatively inconsequential share and air pollution, depleting water tables and extreme weather conditions will invite ecological collapse.
- The costs of transitioning to renewables are huge. And there are technological issues to overcome before clean energy can be brought to scale. And so, energy economics needs to be redefined.
- We have to contemplate a "revolutionary" change. We have to ask the counterfactual and contemplate the counterintuitive — "What institutional, economic, technological, financial and collaborative steps must be taken to flip the ratio between fossils and renewables in the energy basket of emergent India
- A few early steps must be taken by the new government to start this process. It must replace the lens that is currently used to look at the energy sector.
- A general equilibrium macro model is required that captures the linkages between the different components of energy (oil, gas, coal, renewables, nuclear, hydro, bio, non-commercial); and between fuel usage, electricity, mobility, industry, and agriculture, on the one hand, and, ecology on the other.

Integrate energy and environment policy:

- The various ministries currently engaged with energy and the environment should be collapsed into one omnibus Ministry of Energy and Environment.
- This will perforate the current siloed approach to energy policy and enable the new government to view the sector through an integrated and holistic lens. It could more easily track and evaluate the systemic implications of changes in any one or more component variable.
- An "Energy and Environment Security Act" should be passed at the earliest possible opportunity.

- The objective of such an act should be to bring energy and environment into the national narrative; to set out the road map for managing and mitigating the emergent challenge of balancing economic development and energy demands with the goal of environmental protection; and, to mobilise public support for the policy and regulatory changes required to hasten the transition to a non-fossil fuel based energy system.
- Energy data is scattered across various government departments. This hinders policy and investment. The government should establish an integrated energy data centre, whose data should be regularly updated and made available to all players on commercial terms.

Decarbonisation, demand management and efficiency should be the watchwords of the new government's energy policy:

- The focus should be on generating electricity from solar and wind, incentivising electric vehicles, curtailing diesel consumption in agriculture, enforcing standards and emission norms, redesigning buildings and factories to make them carbon neutral and influencing behavioural change towards energy conservation.
- A multipronged thoughts along these lines will weaken the current unhealthy relationship between economic growth, energy demand and the environment.
- The "clean energy fund" which is currently funded through a cess on coal production and is managed by the ministry of finance should be augmented through the issuance of "green bonds" and a clean energy tax.
- This is to intensify research and development on clean energy technologies (battery storage, carbon capture and sequestration, hydrogen, coal gasification, modular nuclear reactors, etc.) and to fund the transmission and distribution infrastructure required for absorbing the flow of clean energy. Its loci of administration should be handed over to those with domain expertise. This will be to safeguard the funds from sequestration into the consolidated fund and to ensure that the conditions are created for incubating innovation, and forging international R and D and technology partnerships.

Energy diplomacy

- The levers of energy and, in particular, oil policy, are today in the hands of autocratic leaders. This "personalisation" of energy politics would not have been an issue in the past when oil was traded mostly against long-term supply contracts. But today, against the backdrop of an integrated, liquid and fungible market characterised by short-term flexible supply deals, this is of relevance especially for import-dependent countries like India.
- The local actions of leaders now have global, supply-related ramifications. The new government should, therefore, look to develop a specialised cadre of "energy diplomats." It should contemplate lateral entrants at mid- and senior levels of government with relevant domain and international expertise.
- It should unshackle the energy public sector units from intrusive bureaucratic oversight to enable their management to respond with agility to unexpected market developments. And it should establish strong personal relations with the leaders of oil exporting states. At a crunch time, the latter could be the peg on which will hang India's supply security.

Intensify exploration and enhance recovery

- India's unattractive geology is the reason why the various bidding rounds for private sector investment in oil and gas exploration have not been a success.
- The government should not stop this effort but it should consider three changes to the current contract terms.
- One, it should replace the current revenue-sharing model with a production-sharing model for new exploration.
- Two, it should link investment in the marginal and smaller discovered fields with access to the domestic retail market and remove the condition that only companies that have invested Rs 2,000 crore will be eligible for a marketing licence.
- Three, it should contemplate bidding out Mumbai High and other major producing oil and gas fields to international players with proven enhanced oil recovery technologies. The current recovery rates of production from these fields are well below the global average.

Increase competition:

- Coal India Limited (CIL) is a major producer of coal but faces huge legacy issues (labour unions, mafia, politics and organisation) which constrain its ability to fully and efficiently harness the country's indigenous coal reserves.
- These issues cannot be addressed without first redrawing the contours of India's political economy.

- The government can resurrect an earlier decision to allow private sector companies into commercial coal mining.
- The consequent pressure of competition will bear positively on the performance of CIL.

Natural gas:

Five early initiatives should be contemplated.

- First, Gas Authority of India Limited (GAIL) should be unbundled into a monopoly gas pipeline company. It should be divested of its upstream (production/ re-gassification of LNG) and downstream (petrochemicals) operations. These can be merged into one or more of the existing PSUs.
- Second, the "common access" principle must be fairly enforced. Every player, private or public, must have equal access to gas pipelines.
- Third, the price of gas should be determined on the basis of market and competitive principles. This principle should apply across the gas value chain, except pipeline transport tariffs which should be linked to return on capital.
- Fourth, a gas trading hub should be expeditiously established.

Finally, special energy courts should be established to expedite adjudication of disputes and ensure sanctity of contracts. The latter have been major deterrents to investment in the energy sector.

- India is expected to drive almost a fourth of global energy demand in the next two decades. Not only should it be pulling its weight on global forums and influence global policy and choices (something that is beginning to happen), there needs to be significant investment in India-specific solutions: The country's medium-term growth potential could otherwise be at risk.

Geo-Thermal and Ocean Energy Technologies

Ocean Energy

- Ocean energy is energy harnessed from ocean waves, tidal range (rise and fall) and tidal streams, temperature gradients and salinity temperature gradients and salinity gradients.
- Around 536 MW of installed ocean energy capacity is in operation at end of 2016, with major share of two large scale tidal barrage plants i.e., 254 MW Sihwa plant in South Korea (completed in 2011) and 240 MW La Rance tidal power station in France (completed in 166).
- Leading countries in Ocean Energy technology are UK, USA, Sweden, Canada, France, SouthKorea. Examples of few large scale Tidal (Barrage) Plants are 254 MW at France (1966), 20 Mw at Canada, etc. ocean Technology, such as Tidal (Current), Wave, Ocean, Thermal
- As per study conducted by IIT Madras, Theoretical Potential for tidal Energy in India is 12500MW, Promising locations are Gulf of Khambhat and Gulf of Kutch (GJ), Sunderbans (WB),Western Ghats (MH), etc. theoretical Potential for Wave Energy In India is 41,000 MW,
- Promising locations are Western Coast of Maharashtra, Goa, Karnataka, Kerala,Kanyakumari, Southern tip of India, etc.

Tidal Energy

- Similar to hydropower generated from dams, tidal water is captured in a barrage across an estuary during high tide and forced through a turbine during low tide. Capital cost for tidal energy power plants is very high due to high civil construction that results in high power tariff.

Wave Energy

- Wave energy is generated by movement of a device either floating on surface of ocean or moored to ocean floor by force generated by ocean waves.

Current Energy

- Ocean current is ocean water moving in one direction. This ocean current is known as Gulf Stream. Research focuses are on two types of PTEC technologies to extract thermal energy and convert it to electric power: closed cycle and open cycle.

Ocean Thermal Energy Conversion (OTEC)

Research focuses are on two types of

- PTEC technologies to extract thermal energy and convert it to electric power: closed cycle and open cycle. In closed cycle method, a working fluid, such as ammonia, is pumped through a heat exchanger and vaporized. In open cycle system warm surface water is pressurized in a vacuum chamber and converted to steam to run turbine.

Geothermal Energy

- Geothermal Energy is a mature renewable energy technology that has a potential to provide clean and reliable energy for power generation and direct heating with cooling.
- Geothermal Energy can be utilized for both electric power production and direct heat applications including Ground Source Heat pump (GSHP) for space or district heating, generating hot water for domestic/industrial use, running cold storages and green house, horticulture, etc.
- Promising geothermal sites for electric power generation are Puga Valley and Chummathang in Jammu and Kashmir, Cambay in Gujarat, Tattapani in Chhattisgarh, Khammam in Telangana and Ratnagiri in Maharashtra.
- Promising geothermal sites for direct heat use application are Rajgir in Bihar, Manikaran in Himachal Pradesh, Surajkund in Jharkhand, Tapoban in Uttarakhand and Sohana region in Haryana

There are three types of geothermal power plants:

- Dry Steam Plants: Uses geothermal steam directly; Dry steam power

  plants use very hot (> 235°) steam from geothermal reservoir.
- Flash Steam Plants: Uses high pressure hot water to produce steam. Flash steam power plants use hot water (> 182°)from geothermal reservoir.
- Binary Cycle Plants: Uses moderate temperature water (107 to 182°) from geothermal reservoir.

Steps to Achieve India's Solar Potential

- India set an ambitious plan for solar rooftop (SRT) with a target of 40 gigawatts capacity by 2022.
- But so far, the achievement has fallen short of the goal. According to the Union Ministry of New and Renewable Energy, only 2,158 megawatt of SRT systems had been installed in the country till December 2018.
- It is unlikely that the country is going to achieve the target within the given timeframe. Further, most of the installed SRT systems are with commercial and industrial consumers, while residential consumers account for less than 20 per cent of total installed capacity.
- Most developed economies started their solar programmes by targeting household rooftops; as a result, they now have a sizable share of installations in the residential rooftop segment.
- China and India, on the other hand, have used large-scale solar installations in an effort to quickly achieve scale and simultaneously push down costs.
- In the case of India, this focus on large utility-scale solar seems to have become an unintended obstruction in the development of the rooftop segment.
- There are clear economic considerations behind industrial and commercial consumers' preference for rooftop systems: Solar rooftop power is cheaper than grid-supplied
- These consumers have the financial resources to make the necessary investments, which are sizable, to install SRT systems.

Steps to be taken by the government

- Achieving significant capacity addition in rooftop solar would require close engagement with numerous small consumers, which is a challenging task in itself.
- Concerted effort would be needed for raising consumer awareness about the benefits of SRT systems and PV technology and their installation.
- Processes for approving net metering applications and disbursing subsidies will need to be efficient and painless to motivate consumers to invest in this new technology.
- Loans need to be made available, which requires significant capacity building of retail bank branches.

- Instead of these much needed policy initiatives and administrative interventions, the government has largely relied on subsidies (70 per cent for hill and north-eastern states and 30 per cent for other states) to drive SRT installation.
- In recent years, the government has taken steps to improve the availability of loans for SRT projects. The Reserve Bank of India has identified solar rooftop as a priority sector for lending.
- Eight public sector banks have included SRT systems under their housing or housing improvement loans.
- Multilateral banks are providing concessional loans against sovereign guarantee to public sector banks to support subsidised lending to the segment.
- Despite this, collective lending from them until 2017 for solar rooftop financing was only to the tune of $1.4 billion, just 3.5 per cent of the total required funding.

Steps to take Indian solar power industry to next level

- Launch of International Solar Alliance, was a significant step to strengthen sector.
- By setting up solar parks, providing viability gap funding support and introducing schemes like KUSUM (aiming to harness solar power for agriculture) and SRISTI (catalyzing adoption of rooftop solar solutions), Govt. has shown its keenness to fast track growth of solar industry.
- Newer advancements in 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 photovoltaics systems) can play a vital role in increasing capacity.
- Considering that tariffs are now significantly lower than other sources of energy, we need to move towards healthier tariffs to help private players work with sustainable business models and attract a higher capital inflow. This will eventually lead to augmented supply and further lowering of prices for common people. Respective state government should accentuate rate of solar power generation with regular capacity addition.
- Steps should be taken to strengthen discom such that they are able to support higher tariffs, honour RPOs and settle power provider's dues on time.
- Reforms in banking systems will go a long way in assisting renewable energy sector. Enabling Ease of Doing Business Government's pursuit of reforms has created a more conducive environment for investments in India which reflects in our steady rise in Ease of Doing Business rankings over past couple of years.
- Achieving ambitious target of 100 GW solar power capacity by 2022 needs a collaborative effort from all stakeholders, including central and state government financers, discom and private players.
- Government has a key role to play not only by providing required policy support but acting as a central coordinator guiding and synchronizing effort from various stakeholders to catalyse solar industry's growth.
- To catalyse India's agricultural energy transition The much-ignored Case: An area that could be irrigated in 24 hours, ends up taking almost 4-5 nights to irrigate completely because the current energy consumption pattern of India's agricultural sector is mired in inefficiency.
- Despite farmers being dependent on the sun for most farming activities, irrigation usually happens quite late at night. This is due to the practice of supplying subsidised electricity to farmers during the midnight hours.
- Done with the intent of reducing the strain on the grid, owing to the daytime loads, the practice inadvertently leads to increased water and energy wastage, as the pumps run throughout the night. Therefore, the energy wastage is compounded further, with disruption in farm yields and significant delays in irrigation of farms.
- India's agricultural sector is responsible for the consumption of over 18% of overall national electricity usage. However, its contribution to the GDP is just over 5%. This discrepancy has been prevalent since the 1970s, when the Green Revolution was on. Well-intentioned reforms like subsidised electricity supply have had the adverse effect of increasing the energy strain even further.
- Meant to alleviate the stress on farmers, low-tariffed or free-of cost electricity has instead led to mounting losses for the distribution companies (discoms), exacerbated further due to high transmission losses. Electricity theft has emerged as another area of concern and has been on the rise due to non-metered electricity usage in the agricultural sector.

Steps needed to rectify this

- The solution, however, is not to curtail the power access to the agricultural sector, as it employs a large part of the population and is a key cog in India's growth engine.

- We need to provide the requisite energy to the sector, albeit in a more sustained manner. With the agricultural sector's electricity demand set to double over the next decade owing to rising irrigation demand for larger cropped areas, newer crop varieties and rising mechanisation, there is a need for introducing focused measures.

The continued agricultural subsidies will lead to piling losses for discoms, along with disruption of the entire energy value chain.

- First, we must ensure farms receive uninterrupted electricity supply during daytime.
- Second, we need to prevent the rising electricity demand from the agricultural sector to bleed discoms further. 'Solar energy has long been the beacon of India's energy transition and can provide a greener energy avenue for the agricultural sector.'
- Solar agri-feeders installed by discoms to transmit energy to farms A solar agri-feeder is a 1-10 MW community-scale solar power plant and is linked to a substation.
- These agri-feeders can provide largely uninterrupted and sustainable 8-10 hours of electricity during the day. It also obviates installation, maintenance and operation costs for farmers.
- Additionally, discoms can support farms when the power supply from the feeders is low due to sporadic sunlight, and can even use excess electricity produced by the feeders in case of low irrigation demand.
- Enable reduction of agricultural subsidy and do not require capital subsidies of their own, from the government
- Offer remarkable scalability, as a large number of small solar power plants can be swiftly installed in the open or unused land of substations across the country
- Eliminate the need for significant infrastructural costs, due to new large transmission lines, which is a challenge faced by large-scale wind and solar deployments. This results in affordable and sustained power supply for the agricultural sector during the day, aided by an easy-to-implement design for setting up the feeders.
- Lower agricultural demands from discoms also have the domino effect of enhancing energy access and affordability for industrial and commercial use.
- This is due to decreased dependence of discoms on the higher tariffs imposed on the industrial sector.
- India's 2 crore electric and 75 lakh diesel irrigation pumps contribute 16 million metric tonnes of greenhouse gas, which is 5% of the nation's total emissions.
- Solar agri-feeders can help alleviate this considerably. The remarkable utility and viability of solar farm feeders is undeniable and has definite relevance in the government's roster of energy sector interventions such as smart metering, renewables proliferation, energy-efficient pumps, and pan-India energy access.

Biogas- A Story Untold

- India is heavily dependent on expensive imported oil and gas imports as well as coal for meeting its energy requirements, it definitely makes more sense to look at alternative resources.
- Waste to Energy programme propagated to recover energy in form of Biogas, BioCNG, power from urban, industrial and agricultural wastes gains importance.
- About 184 waste to energy plants based on urban, industrial and agricultural wastes have been set up in private sector with an aggregate capacity of 315.24 Mweq.
- Compressed Biogas (CBG) has potential to boost availability of more affordable transport fuels, better use of agricultural residue and cattle dung, as well as to provide an additional revenue source to farmers. Called Sustainable Alternative towards Affordable Transportation (SATAT), it is expected to benefit vehicle-users as well as farmers and entrepreneurs.
- CBG can be produced from various bio mass and waste sources, including agricultural residue, sugarcane press mud, distillery spent wash, cattle dung and sewage treatment plant waste. Other waste streams, like rotten potatoes, dairy plants, chicken/poultry litter, food waste, horticulture waste, forestry residues and treated organic waste from industrial effluent treatment plants (ETPs) can be used to generate biogas. It has the potential to replace CNG in automotive, industrial and commercial uses in coming years.

Biogas

- Best cooking energy option Among the various fuel options available (firewood, pellet, biogas, kerosene, liquefied petroleum gas or LPG, piped natural gas or PNG) biogas accounts for the lowest effective greenhouse gas emission; PNG and then LPG are next

- Biogas and PNG are the best cooking energy options. LPG and kerosene are moderately cleaner.
- Firewood and pellet are the most polluting.

Key facts:

- Cooking fuels emit substantial amounts of toxic pollutants (respirable particles, carbon monoxide, oxides of nitrogen and sulphur, benzene, formaldehyde and polyaromatic compounds) which contribute to indoor air pollution.
- Household air pollution causes non-communicable diseases including stroke, ischaemic heart disease, chronic obstructive pulmonary disease (COPD) and lung cancer.
- Close to half of deaths due to pneumonia among children less than 5 years of age are caused by particulate matter (soot) inhaled from household air pollution.
- In households with limited ventilation — common in rural household and semi-urban areas — these pollutants could lead to severe health problems. Initiatives taken to address in-house pollution: National level programmes to ensure that most switch to clean cooking fuels have been initiated since the 1980s. National Project on Biogas Development (NPBD)
- It was launched in 1981-82 by the Ministry of Non-Conventional Energy Sources.
- Though the socio-economic and environmental impact of biogas is well recognized, NPBD has been receiving public attention and scrutiny in India because of its vast potential on the one hand and its poor performance, high mortality and non functionality rates on the other.
- The programme has been hampered by mala fide practices, poor construction material, a lack of maintenance, misrepresentation of achievements and a lack of accountability and follow-up services.

Steps needed to be taken

- To promote biogas in rural and semi-urban areas, adopting the service-based enterprise model with suitable resource availability offers a sustainable approach. It will also help self-drive the programme.
- The model is being successfully implemented in Hoshiarpur, Punjab using a 100 cubic meter biogas plant. The plant supplies clean and piped cooking biogas to 44 households and a school every day. Such models can also generate employment significantly at the grass-root level an important additional benefit of running a biogas programme.
- Promoting and scaling up PNG in urban areas and making LPG just one of the options to choose from rather than it having an edge over others.
- To further enable a consumer to freely make cooking fuel choices, consumption based subsidies need to be replaced with a functional subsidy that is provided on the basis of household income levels and local variables. Possibility of leakages must also be eliminated by ensuring that subsidies of any kind are provided only through direct benefit transfer.

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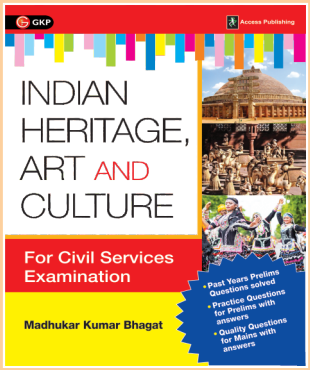

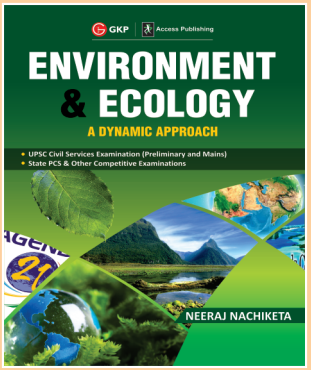

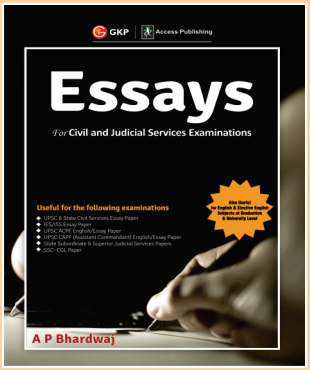

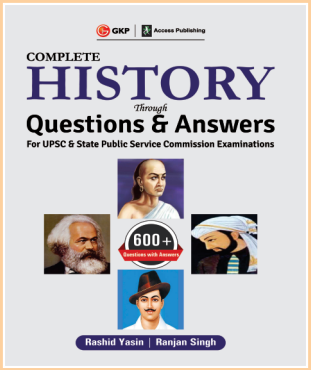

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