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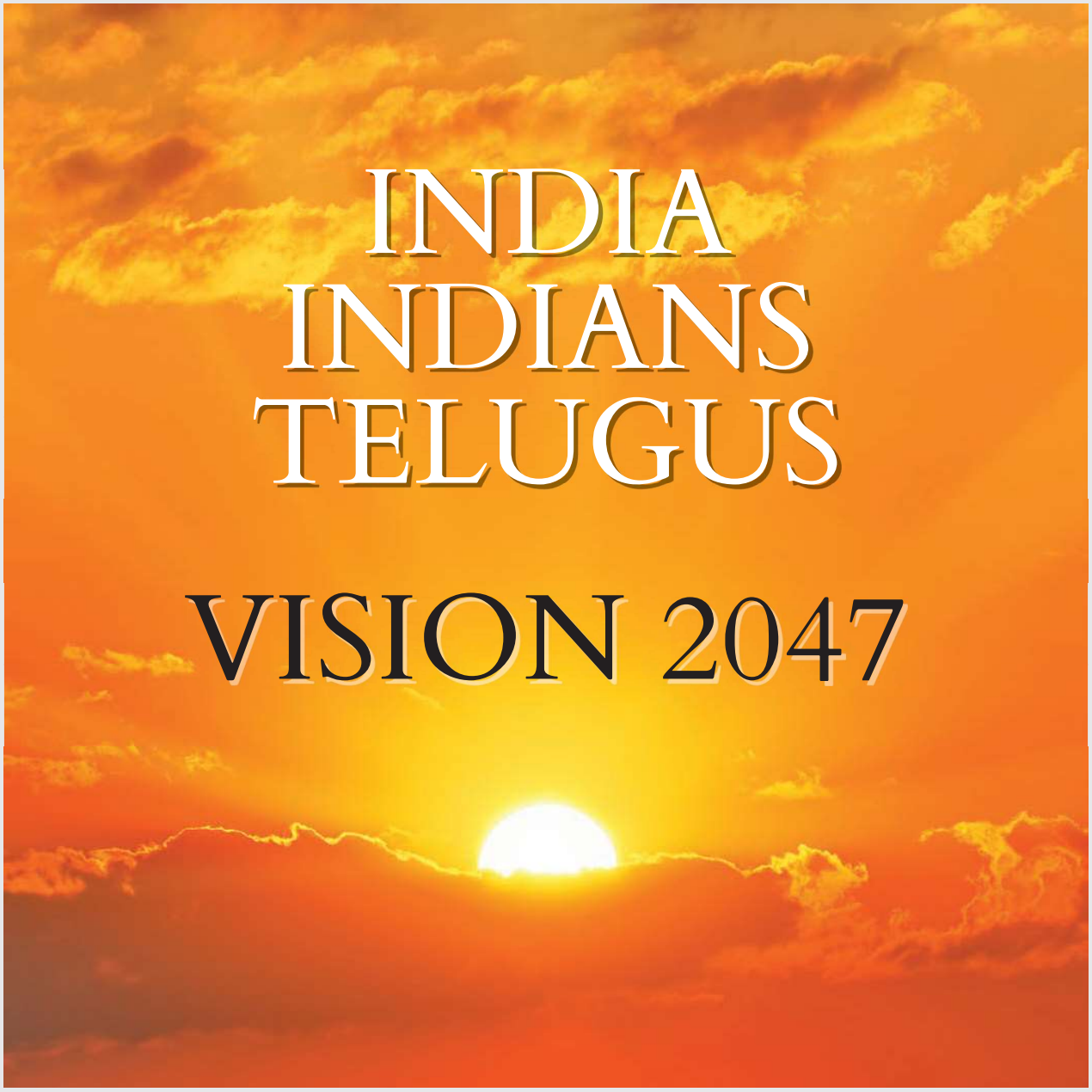

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Global Forum for Sustainable Transformation

FIVE STRATEGIES FOR INDIA AS A GLOBAL LEADER

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Global Forum for Sustainable Transformation

CONTENTS

Strategy

ENERGY - DEMOCRATISATION, DECARBONATION AND DIGITALISATION

Energy Secure India – Now and the Future[14]

Energy and the Indian Economy

The impressive growth of the Indian economy over the past two decades, at a pace of 6.8% per year on average, has resulted in a rise in the country's need for energy. This growth coupled with some other factors are adding to the demand of energy.

- In addition, India is also pursuing a structural economic shift towards manufacturing. A higher share of industries (including manufacturing) in GDP and the material intensity of future economic growth will have profound implications on the outlook for the energy sector.
- The resulting construction activity has led to rising demand for steel, cement, aluminum, plastics and chemicals. India has also emerged as a manufacturing hub for vehicles, electronics and pharmaceuticals as energy demand from industry has tripled over the past three decades.
- Rapid industrialization is coupled with commensurate increase in urbanization. with the share of the urban population increasing from 26% in 1990 to 34% in 2019, and many cities experiencing rapid growth.
- India has, almost, achieved the goal of 100% electrification of houses. Thus access to electricity is not a challenge anymore.
- India's per capita annual income has quadrupled and poverty head count ratio reduced to one fourth since 1991 representing changing lifestyle adding to the demand of energy. Domestic electricity consumption has nearly tripled over the past two decades as near-universal access, and rising disposable leads to more use of household appliances

Among end-use sectors, India's industry sector has been the main source of energy demand growth since 2000, around half of which was met by coal. Transport energy demand grew 3.5 times, while demand in buildings has grown by 40% since 2000, largely because of growing appliance ownership and increased access to modern cooking fuels. The agriculture sector has seen the smallest amount of growth in energy use.

The rising need for energy is a direct result of India's booming economy, which in turn has been propelled forward by the country's increasing demand for energy.. However, India's energy intensity of GDP has improved at an average rate of 3% per year during these three decades, meaning it has required less energy over time to produce an additional unit of economic output. This has happened as a result of the growth in the Indian services sector, energy efficiency improvements and a transition away from inefficient biomass towards modern fuels.

Energy in India Today - Conventional but Transforming

Energy consumption in India has more than doubled since 2000, propelled upwards by a growing population and robust economic growth. Near-universal household access to electricity was achieved in 2019, meaning that over 900 million citizens have gained an electrical connection in less than two decades. However, electricity use on a per capita basis is one third of the global average[15], (1255 kWH in 2021-22) and there are widespread differences in energy use and the quality of service across states and between rural and urban areas. The affordability and reliability of energy supply are key concerns for India's consumers. Since 2000, India has been responsible for more than 10% of the increase in global energy demand. On a per capita basis, energy demand in India has grown by more than 60% since 2000, although there are widespread differences across different parts of the country as well as socio-economic groups.

The current energy demand in India is about 1000 Mtoe. The International Energy Agency has made projections for the future trajectory of energy sector growth in India up to 2040.[16] These four scenarios are computed based on four possible growth trajectories of economy of India. The energy demand[17] of India is expected to increase by about 50% to reach a level of about 1500 Mtoe.

On the supply side, coal remains the predominant energy supplier by accounting for about 57% of total demand. Traditional biomass – primarily fuelwood but also animal waste and charcoal – was the largest energy source in India in 2000 after coal, constituting about 25% of the primary energy mix. Overall energy demand has doubled since , but the share of traditional biomass in the energy mix has decreased to 12% in 2019, largely because of efforts to improve access to modern cooking fuels, in particular LPG.

In the power sector, fossil fuel accounted 57% of total installed capacity as of May 2023[18]. Renewables accounted

14. Adapted from IEA, 2021. India Energy Outlook 2021 - World Energy Outlook Special Report International Energy Agency, Paris. https://www.iea.org/reports/india-energy-outlook-2021
15. Press Information Bureau, Government of India, 15 December 2022
16. IEA, 2021. India Energy Outlook 2021 - World Energy Outlook Special Report International Energy Agency, Paris
17. https://www.statista.com/statistics/1201750/india-total-primary-energy-demand-share/
18. https://powermin.gov.in/en/content/power-sector-glance-all-india

for 41% of which 11.2% is hydro, 10.3% is wind and 16.1% of solar. The rise of solar PV has been spectacular; the resource potential is huge, ambitions are high, and policy support and technology cost reductions have quickly made it the cheapest option for new power generation. In fact, the Government of India has announced to add 50 GW of renewable energy capacity (10 GW per annum of wind) for five years starting from FY 23-24 to achieve the 500 GW capacity of non-fossil fuel by 2030. This is in accordance with the announcement by Prime Minister at CoP26. The existing non-fossil installed capacity makes this goal all the more important. . India currently has a total renewable energy capacity of 168.96 GW (as on 28th February 2023) with about 82 GW at various stages of implementation and about 41 GW under tendering stage. India has emerged as one of the world leaders in energy transition.

As per International Energy Agency

- Transport is currently the fastest-growing end-use sector in terms of energy demand, and urbanization will foster further growth. In many Indian cities, increasing demand for transport has so far led to much congestion and poor air quality. This has prompted a range of policy initiatives on fuel efficiency and quality, mass transit, and the electrification of transport. However, today's policy settings are not yet enough to avoid a large projected increase in oil demand for road transport, which doubles by 2040. There is a doubling in oil demand in road transport by 2040 in the STEPS, largely as a result of the addition of 170 million passenger cars and 25 million trucks to the vehicle stock between 2019 and 2040. Oil consumption is also lifted by a tripling of feedstock demand in the petrochemical industry. However, the transport sector energy consumption source may change from oil to electricity and/or hydrogen depending upon commercialization of EV and Green Hydrogen technologies.
- Industry is the end-use sector that currently uses most energy, and its share in total final consumption will rise from 36% today to 41% by 2040.
- The electrification of the Indian energy economy continues apace in all scenarios. The share of electricity in total final consumption grows in all sectors, and particularly in the buildings sector, where there is a continued pivot away from traditional biomass and a steady uptake of appliances. In the STEPS model, the share of demand met by electricity rises from around 17% today to nearly a quarter by 2040.
- The dominance of coal in India's energy system continues to recede. Coal is the slowest growing energy source in the STEPS, meaning its share in the energy mix falls from 44% in 2019 to 34% by 2040. As the incumbent fuel in the power sector, coal faces strong competition from renewables in general and from solar PV in particular.

The energy mix in India becomes much more diverse. More than 80% of the demand is now met by coal, oil, and traditional biomass.. In 2040 modern bioenergy and renewables including solar, wind and hydropower meet nearly a quarter of India's total energy demand in the STEPS. Primary energy use per unit of GDP falls by half as the link between economic growth and energy consumption weakens further.

In the STEPS, total CO2 emissions in 2040 are 45% higher than in 2019, and emissions per capita also rise, but emissions intensity goes down significantly. India's NDC under the Paris Agreement include a reduction by 2030 in the emissions intensity of GDP by 33-35% compared with 2005 levels. The energy sector achieves this target under the STEPS, with a CO2 emissions intensity reduction of over 40% by 2030.

Issues in India's Energy Sector

Geographical Variation in Energy Consumption

Within India, there is considerable variation in overall energy use across states, resulting from differences in economic and demographic trends, resource availability and industrial profiles. A detailed review of the available state-by-state data shows that the range between the lowest-consuming and highest-consuming states varies by a factor of five measured in toe[19] units.

19. toe = tonnes of oil equivalent

Energy and Economic Indicators in Selected States in India, 2018

States	Urban Population (million)	Rural Population (million)	GDP per capita (PPP) ($)	Total final consumption per capita (toe)	Electricity demand per capita (kWh)
Higher Income	192.7	233.8	12,159	0.6	1,615
Delhi	16.4	0.4	19,970	0.6	1,548
Haryana	8.8	16.5	12,900	0.8	2,082
Telangana	13.6	21.4	11,170	0.5	1,896
Karnataka	23.6	37.5	11,520	0.6	1,396
Kerala	15.9	17.5	11,150	0.5	757
Gujarat	25.7	34.7	10,790	1.1	2,378
Uttarakhand	3	7	10,860	0.5	1,467
Maharashtra	50.8	61.6	10,480	0.5	1,424
Tamil Nadu	34.9	37.2	10,590	0.5	1,866
Middle Income	84	220.6	6,540	0.5	1,129
Punjab	10.4	17.3	8,470	0.6	2,046
Andhra Pradesh	14.6	35	8,260	0.5	1,480
Rajasthan	17	51.5	6,040	0.5	1,282
West Bengal	29.1	62.2	5,980	0.4	703
Chhattisgarh	5.9	19.6	5,290	1	1,961
Odisha	7	35	5,200	1	1,628
Lower Income	88.7	352.1	3,930	0.3	647
Madhya Pradesh	20.1	52.6	4,970	0.4	1,084
Assam	4.4	26.8	4,490	0.3	341
Jharkhand	7.9	25.1	4,150	0.6	938
Uttar Pradesh	44.5	155.3	3,640	0.3	606
Bihar	11.8	92.3	2,400	0.2	311

Notes: kWh = kilowatt-hours

Average citizens in Delhi consume about half of the global average, while their counterparts in Bihar consume less than 20% of the global average. Traditional cooking fuels are most prevalent in states with lower per capita income. In states with higher per capita incomes, the share of electricity and oil products - which include transport fuel and also LPG - is higher, and it rises with increasing energy use.

Access to Clean Cooking

Having electrified nearly every household in the country, India's next major challenges lies in achieving a full transition to clean cooking. As per National Family Health Survey 5 nearly 40% of Indian households do not use clean fuel and continued to rely on traditional uses of biomass for cooking, mostly in rural areas. This percentage is 57% for rural areas. Access to clean cooking goes

beyond technical availability: it also extends to issues of adequacy, reliability, convenience, safety and affordability. Affordability is the key factor that has made biomass hard to dislodge as a cooking fuel. In rural India, biomass and other traditional fuels are practically free or are available at a very low cost, compared with a significantly more expensive cylinder of LPG.

There has also been growth in the use of pipeline natural gas (PNG) in urban areas. In April 2019, there were 5 million domestic PNG connections, over 90% of which were concentrated in four Indian states. The government now has plans to expand this city gas distribution network to cover 70% of all households by 2030. There is also potential for an accelerated uptake of induction and other electric cooking appliances, especially in urban areas, even though they accounted for less than 1% of cooking energy demand in 2019.

Mobility and Transport

With a growing economy, Indians are now travelling farther than ever before. On average, Indians travel nearly 5 000 km each year, a threefold increase since 2000. Vehicle ownership per capita has grown five-fold since 2000. The rapid growth of mobility has been enabled by the expanding road network in India, which increased from 3.3 million km in 2000 to 5.9 million km in 2016. India's total road network is now the second-largest in the world, behind the United States.

Indians are also travelling on rail twice the distance they did in 2000. India's per capita distance travelled on rail increased from 430 km in 2000 to nearly 860 km in 2019.

There has been a steady growth in India's aviation industry over the past decade. The per capita distance flown in India was 10 km in 2019, which is three times as much as 10 years ago. Domestic passenger numbers, too, have nearly tripled in the last decade to over 140 million, up from around 50 million in 2010

As Indians travel more and transport freight in larger volumes, the transport sector has become the fastest-growing energy end-use sector in the country. Energy use in India's transport sector has increased fivefold over the past three decades, reaching more than 100 Mtoe in 2019. While other sectors are fuelled by relatively diverse sources of energy, transport is heavily reliant on oil, with 95% of demand being met by petroleum products. Just under half of India's oil demand is accounted for by transport.

Towards Goal of Net Zero Transition

India declared to be Net Zero by 2070 at COP26 during 2021. It presented its Long-Term Strategy for Low Carbon Development (LT-LEDS) at COP27. In December 2022, a "Net Zero Emissions" Bill was introduced to provide a framework to achieve net zero emissions by 2070. It provides for specific action areas for transport, industry, power, urban sectors and building. India has set itself a goal to reduce the emission intensity of its gross domestic product by 45% from the levels year 2025 to the year 2030. It has also kept a target to achieve about 50% cumulative electric power installed capacity from non-fossil fuel based energy resources by 2030. India has also put forward a program called Lifestyle for Environment (LiFE)to propagate a healthy and sustainable way of living.

Renewals - Solar and Wind

The most remarkable story in India's power sector in recent years has been the growth of solar PV and wind, which have rapidly increased their share of the overall energy mix in recent years as coal and hydropower capacity growth has slowed. Over the past five years, solar PV capacity has grown at an average growth rate of around 60% and wind capacity of around 10%, outpacing the 7% growth in overall installed capacity.

The policy actions that have facilitated the growth of grid-connected renewables include reverse auctions resulting in progressively falling prices, lower corporate tax rates for developers, renewable purchase obligations mandating utilities to procure a certain minimum purchase of renewable power, investment in transmission infrastructure, and support for solar parks that help reduce project development and land acquisition risks.

However, there are still important structural, regulatory and institutional challenges that could hamper further growth, and progress has been uneven across different renewable technologies. The challenges include the poor financial position of many state distribution companies, difficulties in obtaining access to finance and in acquiring land, grid congestion, and uncertainties over grid infrastructure development.

DECENRATLISATION - Local Grids - Local Production and Local Consumption

The expansion of rooftop solar has lagged the growth in utility-scale projects, constrained by higher costs and the lack of attractive financial models for consumers. Rooftop solar had a share of 40 GW in the 100 GW solar target for 2022, but deployment remains at well under 10 GW. Similarly, despite an identified potential of 10 GW to 20 GW, offshore wind has not yet taken off in India owing to the high cost of capital and to supply chain and infrastructure bottlenecks.

In addition to rooftop solar, solar energy production in agriculture fields holds the potential of large scale local production and local consumption. Similarly, greenhouses with solar panel on top will not only improve the productivity commerce save water but also will generate power to run the greenhouses and the surplus can be shared with the grid.

Another advantage of this local production and consumption would be to set up local grids integrated with main grids and feeders. This local grid can be remotely monitored using current technology. The local production and local consumption will also reduce the cost of transportation of energy and thus improving overall efficiency. Dedicated policy framework and incentive schemes need to be put in place to tap this huge potential and to reduce the cost of energy. It will also bring down the subsidy bill of the states towards the agriculture consumption and thus improving the financial health of distribution and transmission corporations.

E-Vehicles

While India has a range of policies that support the increased adoption of a wide variety of electric vehicles (EVs), electrification in road transport so far has largely come from two-and three-wheelers. The number of electrified two-and three-wheelers has grown by more than 60% each year on average since 2015, and there were 1.8 million such vehicles in 2019. Despite this rapid rise, they still constituted only 3% of overall two-and three-wheeler sales that year. The electrification of transport has accelerated in other modes of transport too. India's railway network now has a target of 100% electrification of its tracks by 2022, up from 51% of the railway network (in route kilometres) in 2019. There has also been a rapid increase in urban light rail in cities. In 2020, over 650 km of metro rail was operational in 18 cities.

To increase the uptake of EVs, a subsidy program called the Faster Adoption and Manufacturing of Electric Vehicles (FAME) was introduced in 2015. The second phase of the policy, FAME-II, was approved in 2019 with a budget of $1.4 billion for a five-year period. This includes policy incentives for the purchase of electric and hybrid vehicles as well as for the installation of charging stations.

To ensure the development of EV charging infrastructure, the Bureau of Energy Efficiency has laid out targets for the installation of at least one publicly accessible charger within a grid of 3 km by 3 km in cities, and one charging station every 25 km on both sides of highways. There is an additional target of one fast-charging station every 100 km on highways. The government has also complemented its measures to promote the use of EVs and associated infrastructure by announcing a production-linked incentive for the manufacture of advanced chemistry batteries for EVs, renewable energy and other applications. However, as many of these incentives are relatively recent, much of the growth in vehicle electrification lies ahead. Lighter and longer life battery, more kilometer per charge and charging infrastructure are key concerns in the sector.

Bio-Fuel and CNG

In April 2017, India put in place corporate average fuel consumption (CAFE) fuel efficiency norms for passenger cars, and these will become more stringent from 2022. The government mandated the leapfrogging of vehicle fuel standards from Bharat Stage-IV to Bharat Stage-VI for all new vehicles sold starting April 2020. This standard is in line with Euro-6.

A comprehensive National Policy on Biofuels (NBP) was approved in 2018 that envisages a target of 20% blending of ethanol in petrol and 5% blending of biodiesel in diesel by 2030. India's push for compressed natural gas (CNG) in transport over the past decade has resulted in the doubling of CNG use in transport since 2010. There are now over 3 million CNG-fuelled vehicles registered in the country, 92% of which are concentrated in four Indian states. These vehicles are largely three-wheelers, buses and cars, most of which are used for shared mobility, for example as taxis, or for public transport. There is a need to expand the CNG distribution infrastructure to other states to meet the targets set by government of India.

Green Hydrogen as a Renewal Alternative[20]

India's distinct advantage in low-cost renewable energy generation makes green hydrogen the most competitive form of hydrogen in the long run. This enables India to potentially be one of the most competitive producers of green hydrogen in the world. Green hydrogen can achieve cost parity with natural gas-based hydrogen (grey hydrogen) by 2030, if not before. Beyond cost, since hydrogen is only as clean as its source of generation, green hydrogen will be necessary to achieve a truly low carbon economy. It will also enable the emergence of a domestically produced energy carrier that can reduce the dependence on imports for key commodities like natural gas and petroleum. India intends to be a global hub for green hydrogen to be the basis of green growth through green jobs.

Hydrogen demand in India could grow more than fourfold by 2050, representing almost 10% of global hydrogen demand. Initial demand growth is expected from mature markets like refinery, ammonia, and methanol, which are already using hydrogen as industrial feedstock and in chemical processes. In the longer term, steel and heavy-duty trucking are likely to drive most of the demand growth, accounting for almost 52% of total demand by 2050. From a price parity basis alone, green hydrogen's share of this demand could grow from 16% in 2030 to almost 94% by 2050. This translates to an implied cumulative electrolyser capacity demand of 20 GW by 2030 and 226 GW by 2050, promising a sizeable opportunity for indigenous manufacturing of a global emerging energy technology. The cumulative value of the green hydrogen market in India could be $8 billion by 2030 and $340 billion by 2050. Electrolyser market size could be approximately $5 billion by 2030 and $31 billion by 2050.

Adoption of green hydrogen will also result in 3.6 giga tonnes of cumulative CO2 emissions reductions between 2020 and 2050. Energy import savings from green hydrogen can range from $246 billion to $358 billion within the same period. Beyond the financial savings, the energy security that green hydrogen provides will translate to less volatile price inputs for India's industries as well as strengthen India's foreign exchange situation in the long run.

The Government of India on 4th January 2023 has approved the National Green Hydrogen Mission. The initial outlay for the Mission will be Rs. 19,744 crores with following likely outcomes by 2030:

- Development of green hydrogen production capacity of at least 5 MMT (million metric tonne) per annum with an associated renewable energy capacity addition of about 125 GW in the country
- Over Rs. 8 lakh crores in total investments
- Creation of over 6 lakh jobs
- Cumulative reduction in fossil fuel imports over Rs. 1 lakh crores
- Abatement of nearly 50 MMT of annual greenhouse gas emissions

The Mission will have wide ranging benefits- creation of export opportunities for green hydrogen and its derivatives; decarbonization of industrial, mobility and energy sectors; reduction in dependence on imported fossil fuels and feedstock; development of indigenous manufacturing capabilities; creation of employment opportunities; and development of cutting-edge technologies. The Mission will facilitate demand creation, production, utilization and export of green hydrogen. Under the Strategic Interventions for Green Hydrogen Transition Programme (SIGHT), two distinct financial incentive mechanisms – targeting domestic manufacturing of electrolysers and production of green hydrogen – will be provided under the Mission. The Mission will also support pilot projects in emerging end-use sectors and production pathways. Regions capable of supporting large scale production and/or utilization of hydrogen will be identified and developed as green hydrogen hubs.

The current significant limitations are the high manufacturing and transportation costs of hydrogen. To reduce the cost of production and transportation, investment in research and development is essential. Some of the big Indian companies have identified the business potential of green hydrogen as the next oil. India desires to have first mover advantage in developing the technologies related to production transmission and utilization of green hydrogen to emerge as exporter of energy from the current status of net importer of energy.

The government needs to speed up the enabling policy framework, robust standards and regulations framework , a public-private partnership framework for R&D which is goal-oriented, time bound, and suitably scaled up to develop globally competitive technologies. A coordinated skill development programme also needs to be taken up as the requirement for green jobs will be increased in the years to come.

20. Adopted from Niti Aayog & RMI, 2022, Harnessing Green Hydrogen - Opportunities for Deep Decarbonization in India. https://www.niti.gov.in/sites/default/files/2022-6/Harnessing_Green_Hydrogen_V21_DIGITAL_29062022.pdf

Water Needs for Energy Sector

Today, the energy sector withdraws roughly 30 bcm of water (the volume of water removed from a source) and consumes almost 6 bcm (the amount withdrawn but not returned to a source). The energy sector accounts for less than 5% of India's total water withdrawals and less than 2% of consumption, but water availability is nonetheless essential for India's energy security. It is estimated that 9 litres of water is consumed for production of one litre of hydrogen. The ambitious program of green hydrogen based energy production would create demand for more water consumption. India would need to scout for places with water availability to set up the green hydrogen production plants.

National Smart Grid – Digitalisation of Energy Sector

The National Smart Grid Mission (NSGM) was established by Government of India in 2015 to plan and monitor implementation of policies and programmes related to smart grid activities in India. The primary aim of the smart grids is to improve reliability of the electricity networks and make the grid amenable to renewable energy inputs through distributed generation. Further, increased efficiencies with smart grid and smart meters empower the consumers to manage their electricity consumption in a better manner and help them in reducing their bills. In addition, the NSGM also envisages capacity building initiatives for distribution sector personnel in the field of smart grids.

Smart grids can be achieved by implementing efficient transmission and distribution systems, system operations, consumer integration and renewable integration. Smart grid solutions help to monitor, measure and control power flows in real time that can contribute to identification of losses and thereby appropriate technical and managerial actions can be taken to arrest the losses. Smart grid solutions can contribute to reduction of T&D losses, peak load management, improved quality of service, increased reliability, better asset management, renewable integration, better accessibility to electricity etc. and also lead to self-healing grids.

Smart grid can therefore transform the Indian power sector in to a secure, adaptive, sustainable and digitally enabled ecosystem that provides reliable and quality energy for all with active engagement of stakeholders.

The features of smart grid include real time monitoring; automated outage management and faster restoration; dynamic pricing mechanisms; incentivize consumers to alter usage during different times of day based on pricing signals; better energy management; in-house displays; web portals and mobile apps; track and manage energy usage; and opportunities to reduce and conserve electricity; etc.

Smart Grid will also facilitate distributed generation, especially roof top solar generation, by allowing movement and measurement of energy in both directions using control systems and net metering that will help "prosumers" i.e., the consumers who both produce and consume electricity, to safely connect to the grid.

The benefits of smart grid deployments to the utilities, customers and the regulators include reduction of T&D losses; peak load management, improved quality of service and reliability; reduction in power purchase cost; better asset management; increased grid visibility and self-healing grids; renewable integration and accessibility to electricity; increased options such as ToU tariff, DR programs, net metering; satisfied customers and financially sound utilities; etc.

Energy Efficiency

Ministry of Power, through BEE, has initiated a number of energy efficiency initiatives in the areas of household lighting, commercial buildings, standards and labeling of appliances, demand side management in agriculture/ municipalities, SME's and large industries including the initiation of the process for development of energy consumption norms for industrial sub sectors, capacity building of SDA's etc.

India's Energy Policies and Governance- Digitalisation

India's energy policies and ambitions are often disparate and sector-specific because they emanate from different ministries and agencies. However, these policies and ambitions all relate to the overall goal of providing affordable, reliable and sustainable energy services.

The energy industry in India is regulated in many ways by both the federal and state levels of government. Under India's constitution, the petroleum, natural gas, aviation and railways sectors come within the legislative ambit of the central government, whereas electricity comes within the legislative ambit of both the central and state governments. As a result, India's energy sector is governed by multiple ministries and agencies at both the central and state levels.

In the central government, various ministries and agencies have energy-related responsibilities under the overall purview of the Prime Minister's Office (PMO). Each of these in turn has under it a range of specialist agencies and

regulatory bodies, as well as public sector undertakings (PSUs), which are publicly owned companies. There are also agencies under the 28 state governments with responsibilities related to electricity, road transport, buildings and energy efficiency; these include State Electricity Regulatory Commissions (SERCs) in charge of managing intra-state transmission, distribution, trade and other aspects of electricity supply. There is also a Forum of Regulators (FOR) to facilitate co-ordination among the multiple state regulatory agencies and the central regulator. The administrative burden of having multiple agencies involved with energy is substantial. To achieve One Nation One Grid in the energy industry, we need creative and digital solutions.

The Government of India has articulated seven focus areas for its energy economy, including a move towards a "gas-based economy", cleaner use of fossil fuels, greater use of biofuels, rapid scaling up of renewables, a focus on electric mobility, a shift towards emerging fuels including hydrogen, and digital innovation across energy systems. There are specific targets to be achieved by 2030, including 500 GW of renewable power capacity, a 15% share of natural gas in the primary energy mix, a 30% share of passenger car sales for eVs and a 20% blending of biofuels in petrol. There are also targets for increased energy efficiency across sectors, affordable housing for all, the electrification of railways, the reduction of crude oil imports, and the ending of coal imports in the 2020s.

India hence needs to pursue multiple policy objectives in parallel, to support a growing population and economy, including energy access, energy security and sustainability. In order to do so effectively, there is a need to approach energy policy making and planning with a view to the system-wide impacts of different policy choices. For example, road or rail transport policies formulated by the respective ministries in India have potential implications not only for transport demand, but also for power generation capacity, refinery configurations, natural gas supply infrastructure, GHG emissions and air quality. And India's policy choices will also have significant impacts for global trends given the scales in its energy demand and consumption. Hence making the right energy sector policy choices will be critical for India to achieve it India@2047 vision goals.