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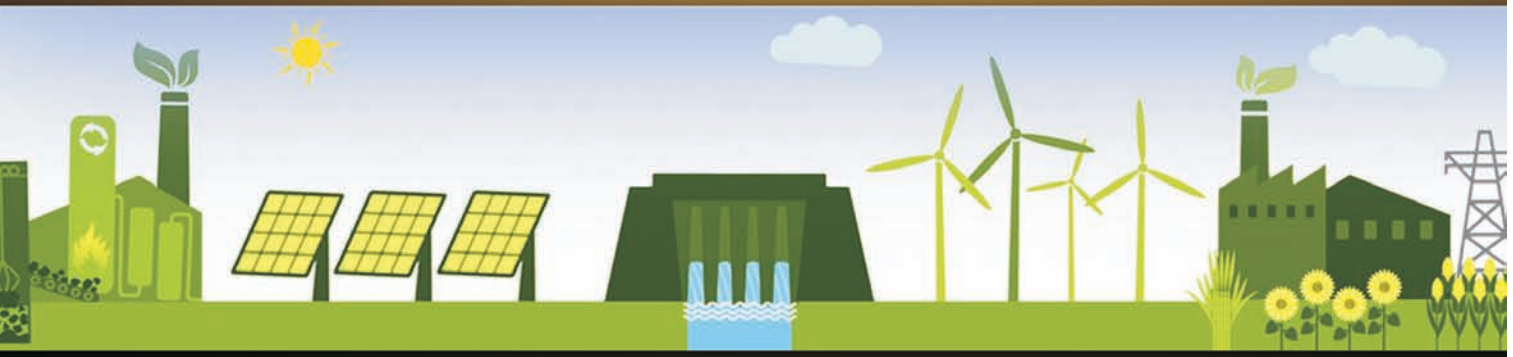

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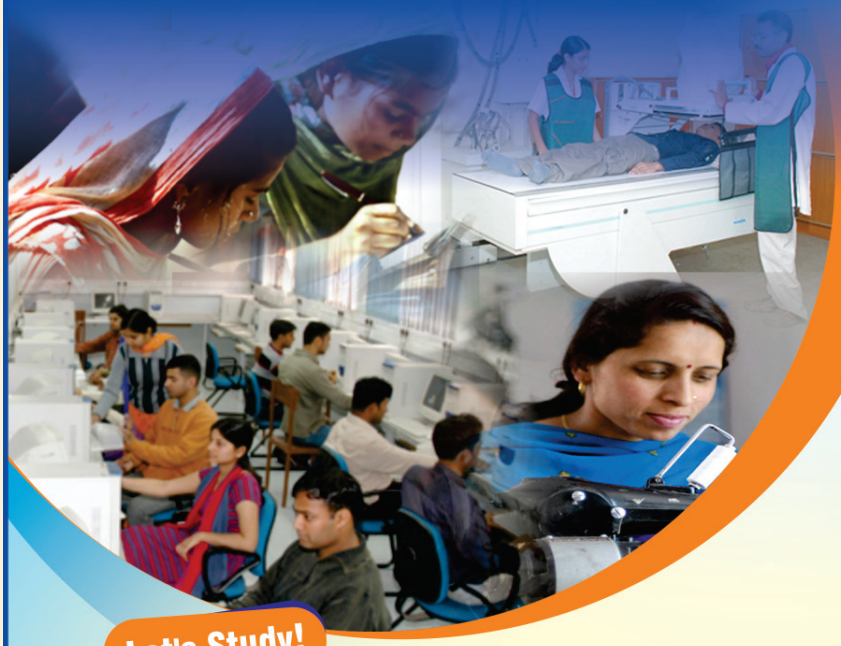

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Let noble thoughts come to us from all sides
Rig Veda

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Chief Editor's Desk

Prometheus- Come Again!

Imagine sitting in a time-machine. We travel back a lac years or so in history. There on the mouth of a cave, a child is playing with stone pebbles. He is throwing it aimlessly here and there, enjoying the sound and sight- the rustle of the leaves, scurrying rabbits running to safety. Suddenly the pebble falls on another stone and there is a spark. Curious, the child starts rubbing the pebbles in the heap of dried leaves. Spark, spark and there is fire! Human civilisation had entered a new phase. It has tamed fire.

We don't know if Prometheus stole the fire from Gods or the child discovered fire playing with the flint-stone or it was the sight of the regular forest fires that gave humans the clue to fire. But the control over the technique of creating fire gave man the first source of energy beyond his own body. And how remarkable it was. It changed the eating habits of people, gave him protection from predators, allowed him to expand his habitat into colder regions and made it possible to work in the dark. Truly, control over the source of energy signified the beginning of human civilisation.

In fact the human civilisation is the history of man's growing control over the sources of energy. Industrial revolution and IT revolution are the two most important phenomena in the modern times. Both of these owe their origin to the ability to control and manipulate energy. Steam engine was the catalyst and harbinger of Industrial revolution, transistor or the semi-conductor device lies at the core of information revolution. We all know that steam engine marked an epochal change in the production capacity and thus the beginning of modern capitalist world. Similarly, we can not imagine the IT revolution without the semi-conductor chip, which is a device to control the flow of electricity between two points on a circuit. Indeed, comprehending the dynamics of energy can provide us with the key for understanding the future of mankind.

It is in this context that the question of energy becomes such a vital thing to analyse and discuss. The entire edifice of a modern economy is built around the production and consumption of huge amounts of energy. Countries like India are heavily dependent upon fossil fuel like coal, gas and petroleum. Unable to meet its requirement, dependence on import becomes unavoidable. The dependence on foreign sources of energy has significant implications for the country from a strategic point of view as well. Similarly, the environmental impact of high energy consumption is also becoming a serious issue in many countries including India. In Beijing recently, smog had become so thick that virtual sunrise was arranged on huge TV screens across the city. The French government imposed heavy restrictions on cars-allowing only even numbered cars to ply on certain dates- to ease the high pollution level in Paris. London imposes congestion tax on cars to cut clogging on the roads and reduce the level of pollution.

The issue of energy security requires deeper engagement of the policy makers, industrialists, professionals and common people alike. A country like India has to align its energy policy with its economic imperatives, environmental concerns and strategic realities to secure the national objectives. The model of development based on exploration and consumption of conventional energy sources is coming into question as it looks more and more unsustainable and perhaps undesirable too. There is a serious churning going on in the world to experiment with what is called 'Energy Transition' which refers to 'policy adjustment, market orientation and technological optimisation' to centre-stage renewable sources of energy like wind and solar energy. At the same time, society also needs to rethink and reorient its consumption needs to reduce the energy footprint to enjoy 'intelligent abundance', which is affordable and sustainable and does not burden our pockets or conscience.

It is said that Prometheus gave the power over fire to man after creating him from water and earth because he had become fonder of men than the king of gods Zeus had anticipated. Let us believe his fondness for human race continues despite its follies.

Come again, O Prometheus to help us discover a new fire for a sustainable future and a new light for conscientious living! ❑

Aspects of Energy Security : Trends and Policy Framework

Robin Singhal

Indian policy makers have a difficult task of rebounding Indian economy along a higher growth path. Unless there are concerted efforts to stem the increasing energy import dependence and making the policy and business environment conducive to facilitate the Indian energy systems transformation and adaptation, the much needed macro-economic stability would remain a distant dream

THE CONCEPTUAL basis of *energy security* is much wider than merely securing energy supplies. The existing energy system relies primarily on the use of fossil energy – coal, oil and natural gas for meeting power and non-power demand of final energy. Given the skewed distribution of fossil fuels, securing their supply for meeting the demand for energy is an essential component of energy policy framework for an energy importing country. However, the important aspects of energy security can be broadly classified as *availability, reliability, affordability* and *sustainability*. The *availability* aspect would constitute measures aimed at increasing the endowment of primary energy resources through domestic exploration and production; imports of primary energy resources (and even final energy such as electricity, refined petroleum products as the case may be) from energy supplying countries. The *reliability* aspect captures measures targeted at increasing the resilience of the energy sector to the uncertainties of international energy markets owing to geo-politics, political instability in the energy exporting countries and threats to the energy supply chain from terrorist groups, natural calamities etc. The *affordability* aspect caters to the issues related to energy pricing (such as concerns for volatility) and equity considerations (such as removing energy poverty and universal access to modern energy services). The *sustainability* aspect focusses on the negative environmental externalities arising from the energy system and highlights the need for its transformation and adaptation for addressing vulnerability on account of expected climate changes and increase in the frequency of extreme weather events.[1]

The definition of energy security adopted by the government of India is "we are energy secure when we can supply lifeline energy to all our citizens irrespective of their ability to pay for it as well as meet their effective demand for safe and convenient energy to satisfy their various needs at competitive prices, at all times and with a prescribed confidence level considering shock and disruptions that can be reasonably expected". The *elements* of this definition such as 'all her citizens', 'lifeline energy', 'effective demand', 'safe and convenient energy', 'at competitive prices', 'at all times', 'various needs', 'prescribed confidence level', 'shocks and disruptions', and 'reasonably expected', does reflect the different aspects of energy security as discussed above.[2]It needs to be emphasised here that energy security in itself is an outcome indicator. Such an

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outcome can be achieved if and only if we have an *energy system* in place which qualifies the defining aspects of energy security as outlined.

Energy System: Definition, Importance and the Indian case

Energy system comprises of not just the energy conversion technologies, rather consists of all primary energy resources, processes and technologies required for energy transformation/ conversion, transportation, storage and end-use. It also covers the interactions with the environment as a source of primary energy and as a sink for the assimilation of the various forms of waste generated in all the phases and processes right from the stage of making primary energy available to the stage of final end-use. Broadly speaking, the two essential conditions which the energy system must satisfy to be 'satisfactory' are (i) 'it should be able to guarantee the right quantity and form of energy in the right amount for all the required time and at the place of need' and (ii) 'it should be able to foresee and meet the future needs of an economy'.[3] It is thus crucial that the energy policy through suitable measures should not only aim at ensuring the smooth functioning of the energy system for realising the desired goal of energy security, but also create an environment in which the different stakeholders in the energy value chain participate effectively and their behaviour is oriented towards addressing the social, economic and environmental challenges being faced by the energy sector in the 21st century.

It is thus crucial that the energy policy through suitable measures should not only aim at ensuring the smooth functioning of the energy system for realising the desired goal of energy security, but also create an environment in which the different stakeholders in the energy value chain participate effectively and their behaviour is oriented towards addressing the social, economic and environmental challenges being faced by the energy sector in the 21st century.

The Indian energy system, for meeting the demand for final energy of energy consuming sectors, draws its primary commercial energy supplies predominantly from fossil fuels – coal, crude oil and natural gas. In 2011-12, these fossil fuels taken together accounted for approximately 93.3 per cent of the total primary commercial energy supplied (i.e. domestic as well as imported but excluding non-commercial primary energy such as combustible renewables and wastes). The growing domestic energy demand and supply mismatch reflects a fundamental challenge to India's energy security. The share of energy imports in the total primary commercial energy supplied is estimated at 36.7 per cent in 2011-12 and the share of fossil energy in the total primary energy imports accounted for 99.8 per cent during the same period. The share of imports in the total availability of coal, crude oil & petroleum products and natural gas in 2011-12 is estimated at 19.6 per cent, 76.8 per cent and 22.7 per cent respectively. It is projected that the share of imports in the total availability of coal, crude oil & petroleum products and natural gas would increase to 22.6 per cent, 78.1 per cent and 24.6 per cent respectively in 2016-17 and 27.3 per cent, 81.9 per cent and 23.1 per cent respectively in 2021-22.[4] This increasing import dependence exposes her to the volatile behaviour of the international energy markets and uncertainty owing to the geopolitics surrounding them, creates pressure on foreign exchange reserves causing balance of payments problem and vulnerable to the phenomenon of imported inflation.

Besides energy availability issues, policy makers face a daunting task with respect to other aspects of energy security in realising the faster, sustainable and more inclusive growth. Some of the key challenges in this regard are:

i. Making access to modern energy services universal, reducing the dependence on the non-commercial unclean and unprocessed energy sources such as firewood, cow-dung cakes, crop residues etc., removing the disparity between penetration of electricity for lighting and liquefied petroleum gas for cooking in the rural versus urban areas, ensuring access to electricity in remote areas not connected to the grid.

ii. Transport sector is the leading consumer of petroleum products, which also accounts for a dominant share in its energy mix compared to the other energy consuming sectors. The non-substitutability of petroleum products among the different modes of transport (except railways) has been one of the important factors driving India's demand for crude oil and consequently oil imports. In the case of Indian Railways, the switch from coal to electricity has resulted in the sharp decline in direct coal consumption but the increasing share of electricity in the railways energy mix has driven the consumption of coal indirectly, due to coal being the major throughput for power generation. Factors such as the dominant share of the road transport in the country's total passenger and freight traffic, growing number of registered

Factors such as the dominant share of the road transport in the country's total passenger and freight traffic, growing number of registered motor vehicles, and low per capita vehicle ownership compared to many developed and developing economies do point to the continued dependence on petroleum products as a source of final energy in the times to come under a business-as-usual scenario.

motor vehicles, and low per capita vehicle ownership compared to many developed and developing economies do point to the continued dependence on petroleum products as a source of final energy in the times to come under a business-as-usual scenario. Further, it raises environmental concerns owing to harmful emissions arising from the combustion of petroleum-based fuels in the vehicle technologies causing local air pollution and the release of greenhouse gases contributing to the global problem of climate change.

iii. The industrial, agricultural, commercial and public services consumes a significant proportion of electricity for meeting their demand for final energy. However, coal being a major throughput for power generation necessitates extensive development and deployment of low-carbon, carbon-neutral and carbon-free renewable alternatives for diversifying the energy mix. Of India's total installed capacity for power generation as on 31st March, 2013, coal thermal power plants accounted for approximately 58.3 per cent whereas gas-based thermal power plants accounted for only 9 per cent. The share of hydro, renewables and nuclear power plants in the total installed capacity is assessed at 17.7 per cent, 12.3 per cent and 2.1 per cent.[5] The projected share of coal, accounting for more than half of the power generation fuel mix in India as late as 2030, is a major stumbling block in realising low carbon economic growth and ensuring green development of the Indian energy sector.

Energy Policy: Vision, Actors and Initiatives

Against the above backdrop, the broad *vision* of the Indian energy policy as laid out in the report of the Expert Committee on Integrated Energy Policy "is to reliably meet the demand for energy services of all sectors including the lifeline energy needs of vulnerable households in all parts of the country with safe, clean and convenient energy at the least cost. This must be done in a technically efficient, economically viable and environmentally sustainable manner using different fuels and forms of energy, conventional and non-conventional, as well as new and emerging energy sources to ensure supply at all times with a prescribed confidence level considering the shocks and disruptions that can be reasonably expected". The *approach* thus emphasised is to ensure that the energy policy framework should "create an enabling environment and provide incentives to decision makers, consumers, private firms, autonomous public corporations, government departments, to behave in ways that result in socially and economically desirable outcomes".[6]

The approach thus emphasised is to ensure that the energy policy framework should "create an enabling environment and provide incentives to decision makers, consumers, private firms, autonomous public corporations, government departments, to behave in ways that result in socially and economically desirable outcomes".

The energy policy agenda of the Indian government is implemented through its several ministries and departments such as Ministry of Petroleum and Natural Gas, Ministry of Coal, Ministry of Power, Ministry of New and Renewable Energy and Department of Atomic Energy. The Ministry of Petroleum and Natural Gas (MoPNG) is responsible for administering the exploration and production activities for hydrocarbons and governs the business environment for different stakeholders engaged in this oil and gas sector.[7] The Ministry of Coal (MoC) is responsible for formulation and implementation of policies related to coal (coking and non-coking coal) and lignite in the country.[8] The Ministry of Power (MoP) deals in issues relating to the supply chain of the power sector (thermal power generation, hydro power projects, transmission & distribution) and administers the effective implementation of the Energy Conservation Act, 2001 and Electricity Act, 2003.The Ministry of New and Renewable Energy (MNRE) focuses on promoting the research, development and deployment of new and renewable energy sources with the mandate of reducing India's dependence on conventional energy sources and functions as a nodal ministry for issues pertaining to new and renewable energy for all purposes. The Department of Atomic Energy is assigned the role of exploiting the potential of nuclear technology for securing India's energy future and comes directly under the control of the Prime Minister. Besides these ministries explicitly concerned with the energy agenda and the contribution of the Planning Commission in the energy policy formulation, the Ministry of Environment also plays a crucial role in administering the interactions of the Indian energy system with the environment and takes necessary and suitable measures for its preservation, conservation and protection for realising the goal of sustainable development.

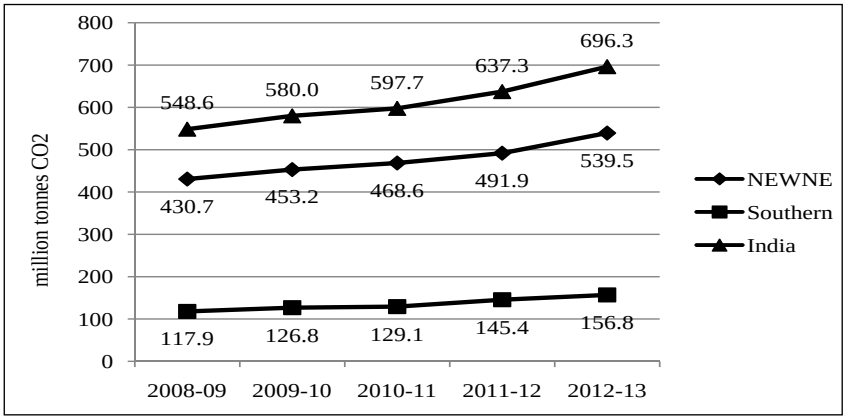
In 1991, the Indian economy had to confront the worst balance of payment (BoP) crisis and the country's foreign reserves had dwindled to the extent that it could hardly finance her two weeks of imports. In response, the GOI undertook several systemic reforms and laid much greater emphasis on the private sector participation in the domestic economy. Subsequently, the GOI further intensified its efforts for attracting foreign capital in the E&P activities and developing hydrocarbon resources in the country. It, thus, announced the fourth exploration round offering 72 blocks (33 onshore and 39 offshore) for competitive bidding in 1991. It also adopted "a system of continuous round-the-year bidding with exploration blocks being

offered every six months". Against four exploration rounds offered during the period from 1979 to 1991, the GOI announced five successive rounds within a span of three years i.e. 1993-1995. In 1995, the GOI offered as many as 28 blocks in its ninth round and allowed the successful bidding company to form a joint venture with ONGC/OIL.[9]

With the objective of increasing participation of both public and private companies in the development of domestic oil and gas reserves i.e. upstream activities, the government of India formulated a New Exploration Licensing Policy (NELP) during 1997-98. Under the NELP, the Government of India has carried out nine bidding rounds till date. The total number of blocks for which the production sharing contracts (PSCs) have been signed were 24 out of 48 blocks in the first round of NELP (or NELP-I), 23 blocks (out of 25) in NELP-II, 23 (out of 27) in NELP-III, 20 (out of 24) in NELP-IV, 20 (out of 20) in NELP-V, 52 (out of 55) in NELP-VI, 41 (out of 52) in NELP-VII, 31 (out of 70) in NELP-VIII and 13 (out of 34) in NELP-IX. Even though the NELP rounds have been able to attract private companies and in providing them a level playing field with the National Oil Companies,[10] however, it is increasingly being felt that there is a need to review and carry out suitable changes in the PSCs in light of the several management/administrative, contractual and policy related issues being experienced by the Directorate General of Hydrocarbons (DGH), responsible for the implementation of such contracts.[11] Given the prospects of increasing import dependence for oil and gas in a business-as-usual scenario, the MoPNG has constituted a committee under the chairmanship of Dr. Vijay Kelkar to "prepare a roadmap for enhancing domestic production of oil and gas and sustainable reduction in import dependency by 2030".[12]

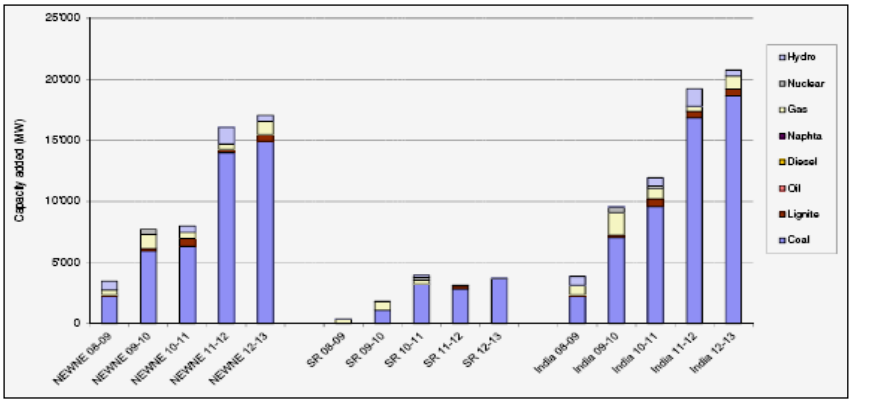
The acquisition of energy assets abroad is also encouraged by the

Figure 1: All India and grid wise break-up of the total CO_2 emissions from 2008-09 to 2012-13, in million tonnes



Source: CO_2 Baseline Database for the Indian Power Sector, Central Electricity Authority, Ministry of Power, Government of India, January, 2014.

Figure 2: Fuel-wise breakdown of new power generation capacity added in India from 2008-09 to 2012-13, in MW



Source: CO_2 Baseline Database for the Indian Power Sector, Central Electricity Authority, Ministry of Power, Government of India, January, 2014.

Indian government. The basic rationale behind such acquisitions is that the equity hydrocarbon assets held abroad can assure the supply of oil and gas in the case of any shock which otherwise can have adverse implications for domestic economic environment.[13] The unsustainable dependence on roadways and transport sector's reliance on petroleum-based fuels calls for concerted policy efforts for not just increasing the share of the more efficient mode of transport such as railways and waterways for effecting passenger and freight traffic, encouraging shift from private to public modes of transport, but also exploring alternative energy sources such as biofuels, electricity and hydrogen for meeting transport sector's demand for final energy. With the aim of exploiting the potential of these alternatives and mainstreaming their use, the government of India has announced – National Hydrogen Energy Roadmap in 2006, National Policy on Biofuels in 2009,and National Electric Mobility Mission Plan (NEMMP) 2020 in 2012. It is noteworthy here that these alternative fuels are secondary in nature i.e. they are to be produced from some primary energy sources. The choice of feedstocks to be used in their production is likely to be influenced by economic, social and environmental factors. Given the resource availability and scientific & technical know-how, ensuring transition to these fuels would require both positive and normative aspects

of policy formulation and economic decision-making.

The grid-interactive, off-grid and decentralised renewable energy technologies (RETs) have significant potential that remains untapped and unexploited. During the 12th Five Year Plan period (2012-2017), the MNRE would undertake necessary policy initiatives to encourage investment in RETs. The deployment of such technologies would be crucial if India is to realise green growth and achieve universal access to modern energy services. It is further emphasised that during the period from 2008-09 to 2012-13,the total CO_2 emissions for all grid connected power stations with an installed capacity of more than 25 MW has increased from 548.6 million tonnes (Mt) to 696.3 Mt. The Indian power system can be broadly classified into two grids – (i) Northern, Eastern, Western and North Eastern (NEWNE) grid and (ii) Southern (SR) grid. The grid wise break-up of the total estimated CO_2 emission for the period from 2008-09 to 2012-13 is shown in the Figure 1.This observed increase in CO_2 emissions is primarily due to the fact that the coal-based capacity installations dominated in the India's total grid-connected power generation capacity added during the period under consideration (see Figure 2).[14]

Concluding Remarks

Indian policy makers have a difficult task of rebounding Indian economy along a higher growth path. Unless there are concerted efforts to stem the increasing energy import dependence and making the policy and business environment conducive to facilitate the Indian energy systems transformation and adaptation, the much needed macro-economic stability would remain a distant dream.

Endnotes

1. The Routledge Handbook of Energy Security, Edited by Benjamin K. Sovacool, Routledge, 2011.
2. Integrated Energy Policy: Report of the Expert Committee, Planning Commission, Government of India, 2006.
3. Energy Systems in the Era of Energy Vectors: A Key to Define, Analyze and Design Energy Systems Beyond Fossil Fuels, Fabio Orecchini and Vincenzo Naso, Springer-Verlag London limited, 2012.
4. Twelfth Five Year Plan (2012 – 2017), Economic Sectors, Volume II, Planning Commission, Government of India.
5. CO_2 Baseline Database for the Indian Power Sector, Central Electricity Authority, Ministry of Power, Government of India, January, 2014.
6. Integrated Energy Policy: Report of the Expert Committee, Planning Commission, Government of India, 2006.
7. Public sector companies (such as Oil and Natural Gas Corporation Ltd, ONGC Videsh Ltd, Oil India Ltd), private sector companies (such as Reliance Industries Ltd, Cairn India Ltd, Essar Oil Ltd), integrated oil refining and marketing companies (such as Indian Oil Corporation Ltd, Bharat Petroleum Corporation Ltd, Hindustan Petroleum Corporation Ltd), stand-alone gas marketing companies (such as Gas Authority of India Ltd, Indraprastha Gas Ltd, Mahanagar Gas Ltd), and liquefied natural gas companies (such as Petronet LNG Ltd, Hazira Group of Companies, ratnagiri Gas and Power Pvt. Ltd and Gujarat State Petronet Ltd) operates in the Indian oil and gas sector.
8. Public sector undertakings such as Coal India Limited, Neyveli Lignite Corporation comes directly under the control of MoC, which also have an administrative control of organisations such as Office of the Coal Controller's Organisation, Office of the Commissioner of Payments in Kolkata and the Coal Mines Provident Fund Organisation.
9. Paper on Review of E&P Licensing Policy, Petroleum Federation of India, New Delhi, 2005.
10. Report of the Committee on the Production Sharing Contract Mechanism in Petroleum Industry, Government of India, 2012.
11. The Hon'ble Prime Minister appointed a committee under the chairmanship of Dr. C Rangarajan in May, 2012 to "look into the design of future production sharing contracts (PSCs) in hydrocarbon exploration" (Source: http://pib.nic.in/newsite/erelease.aspx?relid=84603, accessed on 29th March, 2014). The committee submitted its final report in December, 2012 entitled "Report of the committee on the production sharing contract mechanism in the petroleum industry". Kindly refer to the report for details on the committee's recommendations.
12. The Kelkar committee submitted Part-I of its report in December, 2013. Kindly refer to the report for details regarding the suitable measures recommended for early actions. The committee is also expected to submit its final recommendations (Part-II) during this year which would focus on the development of unconventional oil and gas resources, E&P contract structure and related aspects, institutional mechanism for energy asset acquisition abroad and the domestic hydrocarbon sector, gas pricing and transportation infrastructure etc.
13. The ONGC Videsh Ltd (OVL), a subsidiary of the Oil and Natural Gas Corporation (ONGC) has the mandate of undertaking E&P activities abroad. As of 2010, the OVL had 33 projects in 14 countries and the oil production potential was estimated at 0.19 million barrels of oil equivalent per day (Source: Energy Assets Acquisition: A Comparative Analysis of India and China Policy, Confederation of Indian Industry, New Delhi, 2010).
14. The grid connected power stations considered do not include (i) hydro, wind, biomass and solar photovoltaic stations having installed capacity up to 25 MW, (ii) captive power stations, (iii) small decentralised generation sets, and (iv) stations installed in Andaman and Nicobar Islands and Lakshadweep. Kindly refer to the "CO_2 Baseline Database for the Indian Power Sector, Central Electricity Authority, Ministry of Power, Government of India, January, 2014"for the remaining set of assumptions made in arriving at these estimates. ❑

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Energy, Environment and Sustainable Development

U Sankar

Choice of an optimal energy mix for a country requires careful evaluation of the trade-offs among the alternatives, based on national circumstances, policy priorities, costs and affordability

THE WORLD Commission on Environment and Development (Brundtland Commission) defines sustainable development as meeting the needs of the present generation without compromising the needs of future generations. It stresses inter-generational equity. The World Summit on Sustainable Development 2002 mentions the three components of sustainable development - economic development, social development and environmentally sustainable development, as interdependent and mutually reinforcing pillars. The UN Conference on Sustainable Development 2012 recognizes the importance of the evaluation of the range of social, environmental and economic factors and encourages, where national circumstances and conditions allow, their integration into decision-making. It also resolves to strengthen the institutional framework for sustainable development, which will, *inter alia*, promote the balanced integration of the three dimensions of sustainable development.

Integration of the three pillars of sustainable development in public policies in a balanced measure is a difficult exercise. It necessitates understanding of countries' national circumstances and policy priorities and evaluation of trade-offs among different goals and assessment of costs and benefits of designing and implementing alternative policies in terms of the three pillars.

Energy is vital for economic development and also for human development. There are multiple sources of primary energy ranging from fossil fuels like coal, petroleum and natural gas, hydro, nuclear, solar and renewable energy and also non-commercial energy. There are also multiple goals in energy policy – economic efficiency, access to clean energy to all at affordable prices, environmental sustainability and energy security. In case of fossil fuels, fuel extraction may cause natural resource degradation, conversion of fuel into useful energy causes environmental pollution, some local such as sulfur dioxide, nitrogen oxide and particulate matter and some global like carbon dioxide. In case of hydro power, conversion of forest land requires displacement and resettlement of the indigenous people and ecological disturbance. In case of nuclear power, safety has become a major policy issue. Use of a renewable resource like biomass may involve loss of agricultural output. Hence, the choice of an optimal energy mix for a country requires careful evaluation of the trade-offs among the alternatives, based on national circumstances, policy priorities, costs and affordability.

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Energy Intensity

Energy intensity, a ratio of energy input to gross domestic product, is an indicator of energy efficiency. In India, the energy intensity (kilogram of oil equivalent/US$) declined from 1.09 in 1981 to 0.62 in 2011 [Twelfth Five Year Plan, Vol 2, P130]. The energy intensity in 2010, when measured in terms of 2010 US$ PPP, was 0.191 for India compared with 0.102 for UK, 0.121 for Germany, 0.173 for USA and 0.283 for China. Thus, there is a scope for reducing energy intensity by adoption of energy saving technologies and other measures.

Primary Energy

Actual primary energy supply in India in 2000-01 and projected supply in 2020-21 are given in Table1. During the two decades, a significant reduction in the share of non-commercial energy in total primary energy is planned. This is also a sign of economic progress as commercial energy is relatively convenient to use. The share of net imports of energy products is expected to increase by 50 per cent because of anticipated steep increase in coal imports by nearly 13 times the level in 2000-01and from zero import of natural gas in 2000-01 to 31mtoe in 2021-22. In case of petroleum, India imports about 80 per cent of its crude oil.

The scenario with respect to the supply of domestic commercial energy is given in Table 2. Compared with petroleum and natural gas, India has relatively abundant reserves of coal and lignite, and they provide energy security. However, Indian coal has high ash and moisture content. Environmental issues in coal mining and pollution from use of coal in power generation, manufacturing and transport get public attention. Therefore, the share of coal and lignite in the total commercial supply is not likely to change. As for crude oil, there is expected to be steep fall from 16 per cent to less than 7 per cent. There is optimism that the share of natural gas will increase. Despite a tenfold increase in hydro power its share may fall. As for nuclear power, its share is expected to double, but there are considerable uncertainties in reaching the target. Regarding renewables, they are a secure source, pollution-free and employment- intensive, but achieving this target requires an enabling policy environment.

Table 1: Primary Energy Supply by Source

Source	2000-01	2021-22	2000-01	2021-22
	(mtoe)	(mtoe)	%	%
Domestic commercial	206.45	642.00	47.72	52.64
Domestic non-commercial	136.64	202.16	31.59	16.57
Net imports	89.01	375.60	20.58	30.79
Total	432.61	1219.71	100	100

Source: Planning Commission (2012), Twelfth Five Year Plan, Vol 2, p 133

Table 2: Supply of Domestic Commercial Primary Energy

Item	2000-01	2021-22	% share in	% share in
	(mtoe)	(mtoe)	2000-01	2021-22
Coal and lignite	137.04	429.00	66.38	66.82
Crude oil	33.40	43.00	16.18	6.70
Natural gas	25.07	103.00	12.14	16.40
Hydro	6.40	67.00	3.10	2.65
Nuclear	4.41	30.00	2.14	4.67
Renewable energy	0.13	20.00	0.06	3.12
Total	206.45	642.00	100	100

Source: Planning Commission (2012), Twelfth Five Year Plan, Vol 2, p 133

Efficiency in Energy Supply

Energy is becoming a scarce resource. As India is contemplating 8 per cent GDP growth for next 25 years, as her energy supply is limited and as energy is a universal intermediate and final good, it is essential to ensure adequate supply of reliable and good quality of energy. Least cost supply of each primary energy source is necessary. In the power sector, there are inefficiencies in the supply chain. Many old thermal power plants have low plant load factors due to small size, technological obsolescence and fuel supply bottlenecks. Existing coal steam turbine and natural gas single cycle plants operate at 35 per cent efficiency but pulverized coal advanced steam and natural gas combined cycle plants can operate at 50 per cent efficiency; their emission coefficients (g CO_2 / kWh) are low. Government of India's efforts in attracting supercritical and ultra super critical plants have yielded positive responses, but we need a long term stable policy framework to deal with exogenous changes in fuel prices and other contingencies.

India's transmission, distribution and commercial (TD&C) losses remain very high. The Restructured-Accelerated Power Development and Reforms programme was launched in 2008-09 with the objectives of reducing AT&C loss through establishment of base line data and integrated IT applications for energy audit / accounting and investing in improvement of distribution infrastructure.

Energy Conservation

The Energy Conservation Act, 2001 aims at providing efficient use of energy and its conversion. It established the Bureau of Energy Efficiency. India's National Mission for Enhanced Energy Efficiency contains the following schemes:

The first scheme, the Perform, Achieve and Trade scheme, a market-based mechanism, to enhance energy efficiency in the 'Designated Consumers' (large energy-intensive industries and facilities) includes the following project steps: (a) Setting a

specific energy consumption (SEC) target for each plant and the target will specify by which percentage a plant has to improve its energy intensity from the base line value in a period of three years; (b) within a three-year period (2009-2012), the designated consumers try to reduce their energy intensity according to their target; and (c) those consumers who exceed their target SEC will be credited tradable energy permits which can be sold to designated consumers who failed to meet their target. Designated consumers who fail to achieve their target have to compensate this failure by buying permits. If they fail to do either of this, they may have to pay penalties.

The second scheme is for an accelerated shift to energy efficient appliances in designated sector through innovative measures. These products would be made more affordable in the following sectors: lighting (Bachat Lamp Yojana), Municipal DSM, Agricultural DSM, SME sector, Commercial Building sector and for Distribution Transformers. The third scheme is Standards and Labeling: Step by step notification for mandatory labeling for Equipment & Appliance for Domestic Sectors, Hotel Equipments, Office equipments, Industrial Products, Transport Equipments. The fourth scheme is an amendment of public procurement rules to explicitly mandate procurement of energy efficient products for all public entities. The Energy Conservation Building Code (ECBC) mandates maximum energy consumption norms (per square feet) for new commercial buildings and existing buildings (through retrofit).

It must be realized that one kwh power saved at LT end would amount to a saving of more than 1.25 kWh at the generating end.

Affordable Clean Energy for Poor

Access to clean energy to poor at affordable prices has been an important policy goal in India. The Rajiv Gandhi Grameen Vidyutikaran Yojana Scheme for providing access of electricity to all rural households was launched in 2005. It provides capital subsidy of 90 per cent of the total project cost under the scheme and balance 10 per cent of the project cost are being provided by REC as loan.

Comparison of NSS Survey Round 61 (2004-05) with NSS Survey Round 66 (2009-10) shows that households with access to electricity increased from 54.9 per cent to 67.63 per cent in rural areas and from 92.3 per cent to 93.9 per cent in urban areas. The Twelfth Plan notes that rural per capita consumption was only 8 units per month compared with urban per capita consumption of 24 units. The NSS 66th Round shows that only 15.5 per cent of rural households, compared with 66.2 per cent of urban households have access to LPG.

Under Pricing : Energy Products

Under pricing of petroleum products like kerosene, LPG, diesel and naptha for fertilizer plants and electricity for agriculture and domestic use impose heavy financial burdens on governments, distort the price signals, cause leakages and encourage inefficient use. Anand et al (2013) compares the import parity prices with the regulated prices for four items in November 2012.

Item	Import parity price	Regulated price
Kerosene Rs/ litre	46.9	14 .8
LPG	911.5	410.5
Diesel Rs/ litre	57	47.2
Gasoline Rs/ litre	72.7	68.1

This study concludes that the fuel subsidies are badly targeted with the richest 10 per cent of households receiving seven times more in benefits than the poorest 10 per cent.

An analysis of average revenue/ average cost ratios for 28 State Power Utilities and Electricity Departments in 2011-12, available with Planning Commission (2012 b), shows that in agriculture this ratio was less than 0.25 in 53.4 per cent of the SPUs and EDs and above 0.50 only in 21 per cent of the SPUs and EDs. As for the domestic sector, this ratio was less than 0.5 in 36 per cent of SPUs and EDs and between 0. 50 and 0.75 in 43 per cent of SPUs and EDs. The estimated commercial losses was Rs 37836 crore. The cumulative losses are estimated to be around Rs 1.65 lakh crore.

The Annual Report says that 'the political decision to provide free or subsidized electricity in many states completely destroyed the financial position of the SEBs. Subsidies which were announced by the State Governments were not necessarily paid. Announcement of subsidies was done purely to garner votes during elections. Farmers were offered electricity at flat rates based on pump capacity rather than by extent of use measured through a meter' (p 9). The negative effects include "de-meterisation", cornering of the subsidies by well-off farmers, attributing unmeasured losses under agricultural consumption, power theft and increasing cross-subsidization of agriculture and domestic consumers by commercial and industry consumers. The Report says, 'to make things worse, the tariff that is set is not determined on the basis of any economic rationale but on political expediency. No political party would like to increase tariffs for fear of loss of vote banks and as a result, power subsidies kept on rising to astronomical levels' (p 10). Many initiatives have been taken by the central government to introduce hard budget constraints on the SPUs and the EDs, but the results are disappointing.

Energy and Climate Change

India's National Action Plan on Climate Change highlighted the importance of the problem to Indian economy. It contains eight national missions, two of which-National Solar Mission and National Mission for Enhanced Energy Efficiency - deal with energy. In December 2009, India announced that it would aim to reduce the emissions intensity of its GDP by 20-25 per cent from 2005 levels by 2020. There are a few incentive schemes to promote renewable energy.

In 2009, the government constituted an Expert Group on Low Carbon Strategies for Inclusive Growth under the Chairmanship of Prof Kirit Parikh. The interim report submitted in 2011 lists the policy options and sectoral strategies.

What needs to be done?

In order to ensure that the energy sector acts as a facilitator to achieve 8 per cent GDP growth, guarantees access to clean energy at affordable prices and achieve sustainable development, in all its three dimensions, the following actions are needed:

- Commercialization of the enterprises imposing hard budget constraints.
- The enterprises must be autonomous and accountable and report annually to Parliament/ State legislatures during the budget sessions.
- Every effort should be made to measure the environmental costs of using alternative sources of energy and fix prices based on long run marginal social costs. The price revisions must be depoliticized and made automatic every year.
- Subsidies must be targeted e.g. below poverty line households and marginal and small farmers, and limited to not more than 50 per cent of the costs of providing the services at any time.
- At present, energy supplying enterprises get clearances/ approvals from multiple authorities and ministries. For enterprises dealing with globally traded inputs/outputs, timely responses are needed to respond to exogenous changes in other countries' policies or /and steep increases in domestic input costs. The Cabinet or the Planning Commission may be entrusted with the coordination problem in the public interest.
- Environmental Impact Assessment is obligatory but must be time-bound.
- The regulatory agencies must be knowledge-based, transparent, independent and accountable for their actions/ inactions to Parliament/ State legislatures.
- A White Paper on the adverse impact of inefficient management of energy enterprises and under pricing and politicization of energy pricing may be issued to communicate the unsustainability of the sector and "nudge" changes in the stakeholders' behavior.

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Portal to Improve Energy Efficiency

In a move to further improve energy efficiency on Indian Railways, a web based Electrical Energy Management System, RAILSAVER, has been developed by Centre of Railway Informatics System (CRIS), an autonomous organization under the Ministry of Railways. This portal will be very useful for Indian Railways in reducing carbon foot print which is very important for addressing the challenges of global warming and sustainability of our environment.

The portal RAILSAVER will provide a perfect IT based platform for energy consumption data which will pave the way for systematic collection, assimilation, interpretation and analysis of data in evolving future strategies for conceiving, implementing and further intensifying energy conservation efforts on Indian Railways.

The portal is a part of the project for "Improving Energy Efficiency in Indian Railway System" being executed by Indian Railways under programmatic framework of UNDP through Global Environmental Facility (GEF) funding of US $ 5.2 million. The project envisages defining framework for energy conservation initiatives on Indian Railway system by introduction of energy efficient technologies and adoption of various measures in traction and non-traction sub-sectors.

Slew of measures like adoption of energy efficient luminaries and equipment, deployment of new generation 3 phase energy efficient electric locomotives and electrical multiple units etc. have resulted into substantial savings in electricity consumption in the past. This portal will further facilitate in saving energy upto 15% by the year 2020 through improved energy efficiency measures as laid down in Railway's vision document. The project after implementation will be immensely helpful in creating awareness of energy efficiency measures, understanding importance of such measures, availability of knowledge bank on these measures, availability of training modules amongst many others.

SPECIAL ARTICLE

Composite Development Index: An Explanatory Note

Bharat Ramaswami

The index is not based on a priori views about whether a particular state is less developed or not. It is equally important to note that the index and therefore the allocation of funds is relative. Everybody cannot do well on the index. For this reason, some states that are higher ranked on the development scale would receive less funds than a lower ranked state. This is the logic of a development index

IN MAY 2013, the Government of India constituted a committee to evolve a composite development index of states. The Committee was directed to suggest methods for identifying the backward states that could then be reflected in the devolution of funds from the Central Government to the States. The terms of reference also included a qualifier: the devolution formula must also incentivize performance by including variables that measure the ability of States to use funds productively.

The committee submitted its report on September 1, 2013 *(available at http://www.finmin.nic.in/reports/index.asp)*. The document popularly known as the Rajan panel report (after the Chair, Raghuram Rajan) drew much attention. The report has been controversial.

The Principal Idea

The simplest scheme would be to look at per capita income. Economic growth is measured by the growth in per capita income and surely the idea of balanced regional development would include some notion of parity in per capita income.

The committee was, however, of the view, that the object of a development index is to capture the well being of an average individual in a state. Hardly anyone would contest the view that development is not synonymous with income growth. Indeed, the widespread acceptance of the human development index that combines income with indicators of health and education testifies to the strength of this view.

This suggests that a development index ought to be a composite of income and other social indicators. However, economists have long preferred average consumption expenditures per capita as a better measure of economic welfare. Consumption is less sensitive than income to shocks coming from droughts, prices or policy changes. Secondly, as inequality in consumption is less than the inequality in income, the consumption average is more representative of average standards of living.

To illustrate, consider an example. Suppose state domestic product is relatively high because of a few industries such as mining or oil refining. However, as these industries employ relatively few people, the direct impacts on consumption expenditures will be limited. The state GDP per capita would then be a misleading measure of the well being of an average individual.

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However, in this example, even consumption expenditures may not fully capture economic welfare. This is because there could be indirect impacts of higher state GDP. A richer state would have more tax resources that could be invested in infrastructure, public services and subsidies to essential goods. All of these clearly matter to economic welfare. While subsidies could be captured by consumption expenditures, infrastructure and public services would need additional indicators. A comprehensive development index would therefore have to be averaged across consumption per capita and these other indicators of economic welfare. This is the principal idea that underlies the development index proposed by the Committee.

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Method

We begin with a short summary. The Development Index has two components: a needs index and a performance index. The needs index is a simple average of consumption per capita and other relevant variables. The performance index is essentially the change in the needs index (towards development). The performance index receives a weight of 25 per cent in the overall development index. The performance index is included so that states that use funds productively to further economic welfare (as measured by the needs index) are not penalized in future allocations of funds.

The needs index is a simple average of per capita consumption expenditures, the poverty ratio (which accounts for the inequality in consumption) and 8 other variables measuring access to public services and infrastructures. Six of these variables are education, health, household amenities (provided by public services), rate of urbanization, financial services and a connectivity index (comprising rail and road). The seventh variable is the female literacy rate – the only variable in the index that captures gender specific outcomes. The last variable is the percentage of population that is either Scheduled Caste (SC) or Scheduled Tribe (ST). Unlike other variables, this is not an outcome variable. However, it was included in the index because it is widely recognized in Indian public policy that additional resources are needed to overcome the disadvantages of these populations because of the visible legacy of discrimination.

The performance index is the change in the needs index with minor modifications. In particular, the SC/ST variable is excluded. So are the variables in the connectivity index that relate to Central government investments.

Before the indices are constructed, all the variables are suitably normalized to a 0-1 scale where a smaller score indicates a higher level of development relative to the other states.

The next step converts the indices to points to each state based on need and on performance. The points also take into account the state's population and area. The final step is to compute a state's share in the overall funds to be disbursed. As the points tally favours large states, each state gets a fixed basic allocation of 0.3 per cent. This totals to 8.4 per cent of funds. To allocate the remainder 91.6 per cent, the following procedure is adopted. A state's share based on need is the ratio of the points scored according to need divided by the sum of all points across the states. Similarly, a state's share according to performance is computed. The sum of these two plus the fixed allocation of 0.3 per cent is the state's overall share in funds.

Features

It is important to note that the index does not propose a binary classification of states into developed and under-developed. Rather, it recommends an allocation of funds based on the development index. As is well known, a binary classification tends to be arbitrary because it is typically not clear where the dividing line ought to be drawn. States that are close to each other in the development index might well fall on either side of the dividing line. The index based allocation avoids such issues.

It is important to note that the index does not propose a binary classification of states into developed and under-developed. Rather, it recommends an allocation of funds based on the development index. As is well known, a binary classification tends to be arbitrary because it is typically not clear where the dividing line ought to be drawn. States that are close to each other in the development index might well fall on either side of the dividing line. The index based allocation avoids such issues.

Second, the intent was to construct a transparent index that can be revised with time. To achieve this intent, the Committee restricted itself to those indicators that are contained in official data and about which information is routinely collected from time to time. The needs and performance indices are therefore dynamic and so would the formula for allocation of funds.

Table 1: Base Year Values

States	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
Jammu & Kashmir	50	13.1	18.5	46.9	25.8	883.3	88.1	67.9	22	6.1	31.6	80.6	6.8	43.0	24.8	36.5	0.06	0.37	0.01	3.95
Himachal Pradesh	49	22.9	28.7	66.6	28.6	891.1	95	72.9	20.6	10.1	32.6	94.8	16.5	67.4	9.8	59.5	0.51	2.17	3.57	29.25
Punjab	44	20.9	28.9	43.2	11.4	1034.2	89	49.8	11	2.9	85.5	91.9	18.9	63.4	33.9	48.5	4.17	3.09	2.89	71.18
Uttarakhand	42	32.7	20.9	54.8	25.7	737.4	87.6	63.3	19.7	8.6	44.8	60.3	9.9	59.6	25.7	59.8	0.65	3.72	0.82	25.82
Haryana	60	24.1	19.3	55.5	24.1	979.3	87.2	55.5	13.6	2.7	44.5	82.9	12.7	55.7	28.9	45.2	3.61	3.32	5.74	51.49
Rajasthan	68	34.4	29.7	71.0	40.3	675.4	78	40.8	9.5	5.4	32.9	54.7	8.0	43.9	23.4	28.9	1.71	1.63	2.85	24.95
Uttar Pradesh	73	40.9	21.2	68.6	20.3	606.2	77.5	44.5	10.3	3.5	46.0	31.9	5.6	42.2	20.8	44.1	3.55	2.32	3.69	64.09
Bihar	61	54.4	16.6	80.8	49.5	471.3	65.2	42.7	8.6	2.1	39.6	10.3	2.2	33.1	10.5	21.3	3.59	3.59	4.00	53.80
Sikkim	30	30.9	25.6	36.6	49.2	789.1	94.1	68.7	20.9	6.4	45.7	77.8	13.2	60.4	11.1	29.7	0.00	0.87	2.62	19.81
Arunachal Pradesh	37	31.4	64.8	43.7	46.1	766.8	72.1	61.1	22.6	6.1	32.4	54.7	9.2	43.5	20.8	37.3	0.00	0.47	0.00	11.86
Nagaland	18	8.8	89.1	29.4	56.9	1206.6	93.3	79.9	32.7	3.7	22.9	63.6	5.2	61.5	17.2	15.9	0.08	2.98	2.44	58.44
Manipur	13	37.9	37.0	18.0	39.7	676.9	93.2	79.8	44.3	6.7	11.9	60.0	5.3	60.5	26.6	8.7	0.00	4.30	4.26	21.37
Mizoram	20	15.4	94.5	11.0	50.9	1009.9	95.3	68.7	20.8	11.4	19.6	69.6	14.1	86.7	49.6	31.8	0.01	4.24	0.57	10.44
Tripura	31	40.0	48.4	18.6	49.9	579.2	88.2	59.6	11.9	3.6	21.8	41.8	5.2	64.9	17.1	26.5	0.61	3.81	6.48	105.86
Meghalaya	49	16.1	86.4	48.8	55.1	757.9	86.9	52.6	14.3	11.6	20.1	42.7	6.0	59.6	19.6	20.8	0.00	3.61	4.95	19.27
Assam	68	34.4	19.3	35.4	40.6	627.9	87.1	53.2	12.8	5.5	37.9	24.9	4.3	54.6	12.9	20.5	3.19	3.62	3.07	24.38
West Bengal	38	34.2	28.5	56.3	30.1	718.4	82.9	41.6	11.8	2.7	32.1	37.5	6.7	59.6	28.0	36.8	4.34	2.62	1.65	39.93
Jharkhand	50	45.3	38.1	80.3	39.6	532.5	76.7	45.4	13.3	2.9	20.0	24.3	3.3	38.9	22.2	30.1	2.43	2.26	2.37	7.98
Odisha	75	57.2	38.7	85.1	41.0	472.3	80.2	29	6.1	7.1	19.0	26.9	3.9	50.5	15.0	24.2	1.46	2.38	2.58	14.52
Chhattisgarh	63	49.4	43.4	85.8	32.2	524.2	81	44.4	12	8.5	19.0	53.1	3.8	51.9	20.1	24.1	0.86	1.62	2.30	26.17
Madhya Pradesh	76	48.6	35.4	76.0	42.2	562.3	78.4	41	8.7	8.3	24.6	70.0	6.2	50.3	26.5	27.9	1.59	1.69	2.61	21.40
Gujarat	54	31.6	21.9	55.4	37.3	838.3	85.6	36.5	10.9	3.4	46.5	80.4	12.5	57.8	37.4	37.8	2.69	1.45	9.46	55.19
Maharashtra	36	38.2	19.1	64.9	36.8	851.3	89.1	51.7	14	3.2	53.4	77.5	14.1	67.0	42.4	48.1	1.80	1.36	10.78	44.84
Andhra Pradesh	57	29.6	22.8	67.0	45.9	728.6	87.6	36.4	8.9	4.4	31.3	67.2	8.6	50.4	27.3	31.0	1.89	1.63	3.29	42.39
Karnataka	50	33.3	22.8	62.5	34.9	726.1	88.3	41.7	11	4.5	31.7	78.5	12.8	56.9	34.0	40.0	1.55	2.00	8.97	57.86
Goa	16	24.9	1.8	41.4	19.6	1127.3	94.6	62.2	8.3	4.7	61.7	93.6	29.1	75.4	49.8	72.8	1.86	7.27	7.54	186.06
Kerala	14	19.6	11.0	16.0	27.2	1106.7	97.6	68.7	16.4	1.8	71.6	70.2	19.1	87.7	26.0	51.1	2.70	3.71	9.74	221.71
Tamil Nadu	37	29.4	20.0	64.8	32.4	818.8	96.1	48.7	11.8	3.5	27.1	78.2	11.2	64.4	44.0	22.8	3.21	3.22	5.54	97.91

Notes:

A IMR (2005-06)
B per centof people below poverty line (2004-05)
C per cent of ST-SC population (2001)
D per cent of Households with no sanitation facilities (2001)
E per cent of Households with no specified assets (2001)
F Monthly per capita expenditure (combined) (2004-05)
G Attendance ratio in age group 5-14 (2004-05)
H Attendance ratio in age group 15-19 (2004-05)
I Attendance ratio in age group 20-24 (2004-05)
J No. of Education institution in primary/junior basic school & middle/sr. basic school per 1000 population (2007-08)
K per cent of Households with drinking water within premises (2001)
L per cent of Households with electricity as primary source of lighting (2001)
M per cent of Households having landline phone, mobile or both (2001)
N Female Literacy rate (per cent) (2001)
O Urbanization Rate (2001)
P per cent of Households with banking services (2001)
Q Rail Route per 100 Sq Km (2004-05)
R Length of surfaced National Highway per 100 Sq Km (2010)
S Length of surface State Highway per 100 Sq Km (2010)
T Other surface roads per 100 Sq Km (2010)

Turning to the findings, Goa has the lowest value on the under-development index and its share according to both need and performance is zero. So it receives only the fixed share of 0.3 per cent. Despite this, its per capita allocation (Rs. 20.6) in Rs. 1000 crores is high because of its small population. For a similar reason, other small states also gain. Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim and Tripura receive small shares, yet their per capita allocations are higher than that of the other states.

An easy way of summarizing the implications of the Committee's report is to look at the ratio of the state's share in funds to its share in population. If this value is above one, then a state receives more than its share of population. If this value is below one, then a state receives less than its share of population.

The states with shares less than their shares in population, in increasing order, are Kerala, Tamil Nadu, Maharashtra, Punjab, Haryana, West Bengal, Gujarat, Karnataka and Uttarakhand. Andhra Pradesh and Uttar Pradesh have fund shares that are about the same as their share in population. The states with fund shares more than their shares in population include Goa, Himachal Pradesh, Sikkim and the North-Eastern States. The larger states in this category, in increasing order of fund share are Assam, Bihar, Jharkhand, Rajasthan, Madhya Pradesh, Chhattisgarh, Jammu & Kashmir and Odisha. These are the states that would gain from the application of a development index.

Questions

There are several questions that need to be addressed in constructing an index like, what variables should comprise the index, how should they be weighted and whether and to what extent performance should be weighted. Much of the criticism of the index surrounds these questions.

The most persistent criticism of the index was the decision to use consumption per capita rather than income per capita. This was the principal objection of the dissenting note to the report. Why should a state like Kerala that has high consumption expenditures only because of remittances rank high in the index? Notice that by this reasoning, India's export of software services cannot be seen as 'development' either.

...a fundamental criticism has been about the place of this report in the wider framework of Centre-State federal transfers. As is well known, much of the devolution of funds happens through the Finance Commission or through central assistance to state plans through the Planning Commission. The Finance Commission is constitutionally mandated and clearly their recommendations do not have to be based on a development index. The Planning Commission allocations are fixed in consultations with states and only a small part of their disbursement is guided by the Gadgil-Mukherjee formula. Therefore, it is not clear what Central funds will be guided by a development index.

Another criticism was why should the indicators be equally weighted. In the technical literature, the method of principal components is often used to compute weights in the construction of indices. The Committee used this method as well and found that the principal components method suggested weights close to the equal weights allocation. A third kind of criticism relates to the ranking of states according to the development index and their shares in funds. The report has been criticized for giving too little to the North-eastern states (even though their fund shares are well above their shares in population) arguing that this would jeopardise their development. In the same breath, commentators (and often the same ones) have chastised the committee for reducing the shares of the states that have done well on the development index. A fourth criticism is that the Committee should have recommended transfers to offset fiscal disabilities. This was not the mandate of the Committee and doing so would have encroached on the domain of the Finance Commission.

Finally, a fundamental criticism has been about the place of this report in the wider framework of Centre-State federal transfers. As is well known, much of the devolution of funds happens through the Finance Commission or through central assistance to state plans through the Planning Commission. The Finance Commission is constitutionally mandated and clearly their recommendations do not have to be based on a development index. The Planning Commission allocations are fixed in consultations with states and only a small part of their disbursement is guided by the Gadgil-Mukherjee formula. Therefore, it is not clear what Central funds will be guided by a development index.

Perhaps one reason for some of the discomfort with the Committee's findings is that the report has insufficient documentation about the raw data that was used to produce the indicators. Although the raw numbers are sourced from official data available in the public domain, it is a formidable task for individual researchers to assemble the entire data themselves. The data used for the needs index is available at http://www.finmin.nic.in/reports/index.asp, (see also the news feature in the Hindu, http://www.thehindu.com/news/national/rajan-panel-report-its-a-battle-of-the-states/article5190290.ece). The spreadsheet at this site does not, however, contain the base year data. Table 1 contains the base year raw data that was supplied to the Committee.[1] For obvious reasons, it cannot be guaranteed that these tables

accurately represent the data used in the index computations. Hopefully, the government would put up the base year data as well.

Concluding Remarks

In this short article, I have attempted to convey the thinking behind the report on the composite development index and also a flavor of its findings. The report itself contains greater detail about the data sources, the correlation between the various indicators, the formula for assigning points, and the findings and how they relate to fund shares through Finance and Planning Commission.

Perhaps because of the media coverage, there has been insufficient appreciation that the index is transparent and based on official verifiable data. The index is not based on *a priori* views about whether a particular state is less developed or not. It is equally important to note that the index and therefore the allocation of funds is relative. Everybody cannot do well on the index. For this reason, some states that are higher ranked on the development scale would receive less funds than a lower ranked state. This is the logic of a development index.

Endnotes

1. The raw data was assembled by a team at the Ministry of Finance that also computed the index. The primary task of the Committee was to develop the methodology. The index computations with state identifiers and the raw data were not seen by the Committee until after the methodology was finalized. ❑

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WHO Certifies India as Polio Free

The World Health Organisation (WHO) today presented official certification to India for its 'Polio Free' status. India is among other countries in its South East Asian region which have been certified as being free of the wild polio virus. This achievement makes the South-East Asia Region, the fourth WHO Region to be certified as polio-free, after the Region of the Americas in 1994, the Western Pacific Region in 2000 and the European Region in 2002.

India embarked on the programme to eradicate the nation of polio 19 years ago in 1995, when the disease used to cripple more than 50,000 children in the country every year. This achievement has been possible with resolute will at the highest levels, technological innovations like the indigenous bivalent polio vaccine, adequate domestic financial resources and close monitoring of polio programme, with which immunization levels soared to 99% coverage and India achieved polio eradication. This unbelievable operational feat has been possible due to the tireless efforts of over a million ASHAs and ANMs who gave a new momentum to polio rounds. A 2.3 million strong team of polio volunteers and 150, 000 supervisors worked day and night to reach every child.

ANALYSIS

India's Energy Security: Challenges & Opportunities

Ritu Mathur

What is important therefore is for India to plan forward towards the transition to prevent energy and infrastructure "lock-ins", and strengthen the wherewithal of the system to absorb new technologies over the next few decades. From a technological perspective, alternative choices are emerging and it is merely a matter of time that the paths that each of these options would traverse become clearer. India, just like any other country should use the next few years in readying itself for a phase where alternatives can play a much larger role

IN THE 1990s, the Gulf Crisis had brought the concept of energy security to the fore. In recent years once again, global realities of the 21st century have further altered the conceptualization of national security, and energy has once again come to the fore as one of its pivotal elements. Given that energy is crucial in provisioning of transportation, industrial development, communication, education and health delivery systems, India needs to focus on ensuring reliable and adequate availability of energy. In order to deliver a sustained growth rate of 8 per cent-10 per cent (the required rate of growth if India has to eradicate poverty and meet its human development goal) till 2031-32, and meet the lifeline energy needs of all citizens, it is estimated that at a conservative level, India would need around 1350 mtoe of commercial energy by 2031-32 as compared to 327 mtoe in 2003-04 (Planning Commission, 2006).Energy is therefore, increasingly being viewed as a strategic commodity which has important implications for ensuring sustained growth of the economy and fulfilment of national development interests.

Energy Security: Implications

Energy security can have several connotations depending on the level at which it is viewed. In a country where millions continue to live without electricity connections for lighting and remain largely dependent on traditional energy forms for meeting their cooking needs, energy security at the household level centres around access to affordable and clean energy choices. Studies indicate that not only do rural households spend a higher proportion of their total household budget on energy (~6 per cent) as compared to urban households (~4 per cent), when accounting for all fuels and electricity *(Pachauri S., Jiang L, 2008)*, but that given the higher share of inefficient traditional fuels used in rural households, often the rural poor effectively end up paying a higher price per unit of useful energy consumed when compared to their urban counterparts. This clearly reflects the lack of choices available to the rural poor, which may sometimes be due to the inability of these households to invest in the upfront costs of the end use equipment, but more often due to the lack of access to these modern energy forms. Energy security to a large section of people that have an electricity connection, is also about reliable electricity supply. A large section of people that have an electricity connection and have an ability to pay for the service, are deprived of reliable and continuous electricity supply, impacting livelihoods and household

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welfare, and making it imperative to resort to the use of more expensive fuels or of fore-going the service. In 2011-12, India's energy and peak shortages were still around 8.5 per cent and 10.6 per cent respectively (CEA, 2012). Frequent power outages imply that residential, commercial and industrial consumers resort to the use of back-up options, often in the form of diesel gensets, that are not only more costly but also more polluting. From such a perspective, energy efficiency and environment are also key elements of energy security.

With a rank of 136 among 186 countries in terms of its human development index (UNDP, 2013), India still has a long way to go in developing adequate infrastructure and services, which would in turn call for significantly higher levels of energy use. This brings in the broader perspective of ensuring adequacy of energy availability and supply at the national level at all times.

Viewed in terms of a globalised world where fuel availability and technological progress should be evaluated across regions and countries rather than within domestic boundaries, a higher level of import dependency need not necessarily be seen as a measure of higher energy insecurity. This may especially be true for countries like Japan, which with no domestic availability of energy resources, have maintained a strong economic position despite sourcing all of their energy needs through imports. Globally, while availability of fossil fuels may not be a major concern, especially with the role that new energy forms and emerging technologies are starting to play in several European countries such as Germany, at present the concerns regarding fuel and technology prices and the geopolitics of fuel supplies are real. Even though India's net energy import bill was around 8 per cent of GDP in 2011-12,increasing reliance on energy imports does raise concerns in terms of sustainability with regard to the infrastructure that would be required for handling and movement of such large quantums of fossil fuel imports, apart from the geopolitical issues and implications on the economy in a scenario of volatile and rising global energy prices. Accordingly, most studies in India have referred to reduced levels of energy import dependency as proxies of energy security.

Increasingly, the concept of energy security has also incorporated an element of energy efficiency and environmental sustainability. Today, the understanding of energy security entails a complex set of coordinated initiatives and the need for energy strategies, policies and regulations to align in making specific choices for the country in charting an efficient, low-carbon and energy-secure growth path for the country.

Energy Security, as defined by the Government in the Integrated Energy Policy document, encompasses three critical dimensions: (a) meeting India's large energy demand to sustain an annual economic growth rate of 8 to 9 per cent through 2031-32, (b) meeting lifeline energy needs of all citizens to address social development, health and safety of the energy poor, and (c) ensuring sustainability in energy supply and use (Planning Commission, 2006).

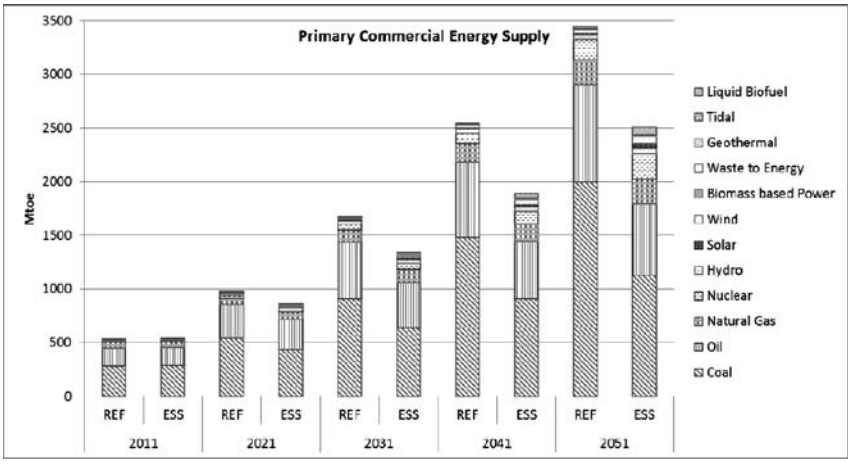
Where is India's Energy Mix Headed?

TERI's analysis using a scenario based approach and an integrated energy systems model (MARKAL) indicates that India's commercial energy requirements may increase by 6 times and 12 times respectively in 2031 and 2051 as compared to 2001 levels, in a Reference scenario (REF) where existing plans and policies continue as per current trends. However, with efforts to improve energy efficiency and enhance share of renewables and efficient alternatives as considered in an Energy Security Scenario (ESS), these levels could reduce to 5 times and 9 times the 2001 levels in 2031 and 2051 respectively. As indicated in Figure 1, the possibilities of moving away significantly from the Reference scenario are relatively small especially till 2031. While several policies are pushing in renewables in a fairly determined manner, with the increase in overall energy requirements, the share that renewables are expected to command is a mere 7 per cent in 2031 in the ESS scenario as compared to 4 per cent in the REF scenario.

Energy: Demand-Supply Gap

With the pace of growth in commercial energy use, India which once had a high share of renewables

Figure 1: Primary Commercial Energy Supply – Reference Energy Scenario vs Energy Security scenario (TERI Analysis, 2014)



(mainly large hydro) in its energy mix, has over time tilted towards a larger and increasing fossil- based share in its generation capacity. When viewed in terms of the country's energy demand-supply gap, India's reliance on fuel imports in total energy supply increased from 36 per cent in 2003-04 to 49 per cent in 2009-10 and 58 per cent to 73 per cent during the same time period if viewed as the share in final energy consumption[1].Studies indicate that even with the best efforts to improve efficiencies and enhance availability of domestic fuels, India's energy import dependency is likely to continue increasing and remain high even with determined efforts to enhance efficiency and increase the share of renewables

An analysis of the current understanding in terms of the prospects for long term availability of domestic conventional fossil fuels and the short term ability to scale up energy from alternative energy resources, does not therefore instil a sense of security or confidence in the country's ability to continue fuelling its energy requirements in a reliable manner, unless determined efforts are made on several fronts.

in the next few decades. Overall fossil fuel import dependency in the REF scenario indicates an increase to 74 per cent and 87 per cent in 2031 and 2051 respectively, while the respective figures in the ESS scenario are 54 per cent and 72 per cent respectively. This indicates that even in the ESS scenario, concerns related to payments of fuel import bills, adequate infrastructure for handling and movement of imports, and environmental implications associated with their use would continue to be significant. The TERI analysis also indicates that while there may be little flexibility in oil import dependency due to lack of substitutes in the petroleum using sectors, coal import dependency in the REF and ESS scenarios are 52 per cent and 21 per cent respectively in 2031, indicating possibilities for shifts to other alternatives.

An analysis of the current understanding in terms of the prospects for long term availability of domestic conventional fossil fuels and the short term ability to scale up energy from alternative energy resources, does not therefore instil a sense of security or confidence in the country's ability to continue fuelling its energy requirements in a reliable manner, unless determined efforts are made on several fronts.

Conventional Fossil Fuels: Issues and Constraints

Coal

The major issues regarding uncertainty with regard to the role that coal would play in India's energy future relate with the extractable reserves of domestic coal, the quality of coal, and the ability to handle and transport the coal to the consumers. Historically, while India was believed to have large resources of coal (India's coal resources were estimated at 267.21 billion tonnes as on 1 April 2009[2]), there is now an increasing consensus that the extractable resources are actually not as large because this includes coal that lies beneath protected areas, forests or water bodies, includes coal that has been extracted and burnt during the past 200 years and includes coal at a depth of 1200 m, whereas mining of coal at present and in the near future is unlikely to go beyond 300 m. CIL's extractable reserves were pegged at around 21 million metric tonne (MMT) (using the Indian Standard Procedure) as per the Draft Red Herring Prospectus as on April 1, 2010. Further, as per the United Nations Framework Classification (UNFC) system, these were estimated at about 18 MMT as on April 1, 2011. Consequently, it is now estimated that coal which can be extracted considering geological, technical, and economic aspects is rather limited, and may not last more than 30-40 years or so at the current rates of production (Batra & Chand, 2011). Moreover, the high ash content of Indian coal and transportation related issues have further contributed to several consumers resorting to the increasing use of imported coal.

Indonesia is the main imported coal supplier to India followed by Australia and South Africa. However, with Indonesia raising

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the price of its coal in 2011, the insecurity surrounding prices of imports has once again come to the fore, making it necessary to look towards alternatives. India's coal based power generation capacity increased from around 76 GW to 130 GW from March 2008 to March 2013, an increase of about 71 per cent, while production of steam coal during this period increased by only around 20 per cent. Consequently, coal imports increased from about 10.2 MT in 2007-08 to about 62.5 MT in 2012-13.

There has continued to be a mismatch in the requirement of coal by power plants and the ability to supply this from domestic sources. Insufficient domestic fuel supply

has already forced NTPC Ltd. (the country's largest state run power producer) to buy costly imports. Accordingly, NTPC is ready to start commercial operations at three new solar power plants (with a total of 45 MW capacity), in line with its intent to raise the amount of energy it generates from renewable resources as it aims to diversify away from conventional fuels.

Oil and Gas

India's crude oil production has more or less stagnated over the past decade or so. The existing fields of ONGC (primarily Bombay High) and OIL (in Assam) are aging and their production may have peaked. Making new discoveries in difficult geologies necessitates state-of-the-art technology and careful consideration of the additional environmental impact of such activities. The concentration of countries supplying crude oil to India in the geopolitically unstable Middle East region exposes the country to potential supply shocks. Further, maritime security concerns and the threat of piracy on the open seas also increase India's exposure to supply shocks.

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Demand for natural gas has been rising especially in the last decade and around 9 per cent of India's commercial energy mix is currently based on gas. The country imported around 18 bcm of LNG in 2012/13, but despite this, around 10 GW of gas based capacity was idle due to unavailability of gas. Given the falling production of natural gas from D6 gas-field, rising domestic demand and global gas market trends, India would need to consider developing LNG infrastructure quickly to increase gas imports. Only two LNG terminals are fully operational, both on the West Coast, since currently gas is imported mainly from West Asia. India will have to expedite construction of new LNG terminals, especially on the East Coast, in order to ensure that the rising demand for natural gas can be satisfied. Moreover, pipelines have to be constructed for transporting the gas from the regasification terminals to customers. Development of transnational natural gas pipelines has been extremely slow since it has been hindered by geopolitical tensions and instability in the region. Further, although the cost economics of importing natural gas shows that trans-boundary pipelines are cheaper than LNG within a certain limit (around 3,000 km), the slow pace of development of the Turkmenistan-Afghanistan-Pakistan-India (TAPI) and Iran-Pakistan-India (IPI) projects are issues that remain challenging since security of supply would remain a concern with pipelines passing through geopolitically unstable countries like Afghanistan and/or Pakistan.

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The emergence of shale gas has created much optimism regarding gas availability, but there are several concerns linked with identifying the shale gas rich basins and acquiring the requisite technology and experience to extract shale gas. The related water requirements may again constrain its role given that India is already a water-stressed country and is rapidly approaching the scarcity benchmark of 1000 m^3 per capita (TERI, 2010) with unabated growth in the irrigation sector and even more rapid growth in industrial and domestic water demand. Potential shale gas bearing areas such as Cambay, Gondwana, Krishna-Godavari and the Indo-Gangetic plains are also expected to experience severe water stress by 2030. Further, land acquisition is also expected to be a serious issue due to the large area needed for fracking and the consequent displacement of people (Batra, 2013).

Nuclear

While India is set to increase nuclear based capacity through its 3-phased program, there are increasing concerns regarding the setting up of nuclear plants. Recent demonstrations in Jaitapur etc. indicate the increasing presence of the NIMBY (not-in-my-backyard) sentiment among society. While additional efforts to enhance nuclear safety are a must, spreading awareness and making transparent the realities regarding the risks and control measures in case of nuclear mishaps are equally important to make it a part of India's solution.

Hydro

Although hydropower power plants are ideal for meeting peak demands apart from bringing in other co-benefits, development of hydropower plants has been beset with several issues due to which additional hydro capacity has not materialised as planned, despite

several policies and measures geared towards development of the hydro potential. Issues such as risk sharing, resettlement and rehabilitation etc. remain a major barrier to accelerated deployment of the country's hydro potential.

Long Term Options

Energy efficiency is clearly one of the important elements that need to be part of India's short and long term solution. There are large opportunities across the energy sector that can also be tapped in the short-term and could help decouple energy intensity from the rapid growth path that India needs to follow.

Although 1.89 million km^2 or 58 per cent of the country's land area receives an average global insolation of over 5 kWh/m^2/day, competition of land area for productive activities limits the solar potential to the barren or uncultivable land areas. Andhra Pradesh, Gujarat, Madhya Pradesh, Rajasthan and Maharashtra have the largest areas amenable for solar installations. Technologically, however, advancements are still required in solar thermal, to handle the problem of intermittency associated with solar power.

Further, renewables are increasingly being viewed as playing an important role in India's long term energy future. Renewables can not only lead to increased energy security, but can also help in climate change mitigation, creation of jobs, industrial development and increased energy access, especially through decentralised generation. The most promising new and emerging alternatives for India include solar with storage technology, off-shore wind-farms, third generation biofuels, and possibly Coal Bed Methane (CBM).

Renewables like wind and solar seem to hold the most promise for India in the years to come. Renewable energy capacity targets set for the 12th Plan period were double that in the 11thPlan period, and with supportive government policies, the renewable targets have not only been met till now but have also been exceeded. MNRE estimates indicate that India has an average irradiance of 4-7 kWh/m^2/day, translating to an average potential of 20-30 MW/m^2. Although 1.89 million km^2 or 58 per cent of the country's land area receives an average global insolation of over 5 kWh/m^2/day, competition of land area for productive activities limits the solar potential to the barren or uncultivable land areas. Andhra Pradesh, Gujarat, Madhya Pradesh, Rajasthan and Maharashtra have the largest areas amenable for solar installations. Technologically, however, advancements are still required in solar thermal, to handle the problem of intermittency associated with solar power.

Solar PV technology has seen rapid progress and costs of solar PV have come down drastically during the past decade, becoming more competitive with conventional power sources. With the advent of the thin film technology, which commands a market of about 20 per cent at present, with crystalline silicon technology accounting for the rest, costs of solar PV have come down further. Recent estimates indicate that cost of grid connected solar PV is around Rs 7-9 per kWh and that of wind based generation is in the range of Rs 5-6 / kWh. While the costs of renewable based generation is still higher than that of coal based generation, when compared with Rs15-20 /kWh, the cost of back-up power based on diesel that several consumers are already paying to private generators in Gurgaon (just on the fringe of the capital city of Delhi) for ensuring reliable and continuous supply of power, this may already be a preferred option for meeting certain specific demands. In the long run, with costs of renewables continuing to decrease as technology progresses, it may well be the case that these emerge as the preferred fuel and technology choices for the country once renewable based power generation reaches parity with current conventional sources and technological hitches of storage have been addressed.Solar rooftop potential in India can also be tapped. It is estimated that around 4.42 per cent of Delhi's rooftop space is available for PV systems (equivalent to around 2.5 GW in Delhi alone)[3].

CBM is another area that India should focus on. While extraction of coal may pose several challenges, CBM may offer a potential solution for enhancing India's energy security. CBM is formed in association with coal at shallow depths, and its extraction does not entail horizontal drilling and involves much less fracturing compared to shale gas. Since 2001, 33 blocks have been awarded, but production has been limited at about 3 bcm per year.

...most of the medium to long term energy projection studies continue to indicate that fossil fuels still need to play a major role as the "bridge fuels" in the next couple of decades at least, especially for grid balancing during the transition period towards a greener economy.

At the global level, new developments in terms of shale gas finds increasing levels of renewables being deployed globally and progress on the efficiency side are however likely to continue contributing to the basket of solutions and what the long term energy mix would evolve as would depend largely on technological progress. However, at present, most of the medium to long term energy projection studies continue to indicate that fossil fuels

still need to play a major role as the "bridge fuels" in the next couple of decades at least, especially for grid balancing during the transition period towards a greener economy.

Way Forward

The challenges facing the country are huge and multi-dimensional, whether we view it in terms of the adequacy of domestic availability and production of fuels to support the future demands of the country, adequacy of sufficient and reliable infrastructure for procuring, handling and moving imports or of ensuring resource efficiency in India's future energy scenario. Even as the country makes efforts for a major transition driven by its sustainable development and energy security considerations, the concerns relate largely to whether the country would face increasing pressures in terms of constraints related to investment flows, infrastructure, having the appropriate skills sets, or in being able to address the additional concerns towards resources including land, water, etc.

When viewed from the climate change angle, at present, there are no break-through technologies that can be scaled up to the levels required without substantial investment in R&D and at the rates required. Investment and capacity additions based on alternative/zero carbon technologies are not forthcoming at the requisite rate, and the logjam at the global level in moving ahead on this front seems to persist.

Till such time that alternative technologies can mature and reach scales that enable large scale commercial viability, India needs to firstly look at securing its fossil based fuel requirements to ensure that existing/up-coming capacities are not stranded due to unavailability of reliable fuel supplies. At the same time, there is a need for some forward planning to also ensure that we do not invest in capacities that may become redundant before the end of their economic life-times. Reliable estimation of future energy requirements and the potential for energy efficiency and savings across sectors should therefore constitute an important element in the planning processes.

In the short to medium term, given that fossil fuels are likely to remain an important part of our energy mix, greater efforts are needed on the exploration side for both coal and oil reserves. Equally important is the need to bring in rational pricing of fuels to encourage efficiency and guide energy producers as well as consumers towards making rational decisions.

India's energy security foreign policy must be closely linked with both its Indian Ocean and South China Sea strategy as well as its Middle East policy, and climate change policies. In order to work towards assured access to imported energy supplies and new energy technologies, India's policies need to be geared towards promoting economic partnerships with countries that have energy resources and technologies.

At a larger level, India's quest for energy security must also factor in resource nationalism among supplier countries particularly in Africa, and consider security of transportation of energy. India's energy security foreign policy must be closely linked with both its Indian Ocean and South China Sea strategy as well as its Middle East policy, and climate change policies. In order to work towards assured access to imported energy supplies and new energy technologies, India's policies need to be geared towards promoting economic partnerships with countries that have energy resources and technologies.

Some of the elements that require careful planning and implementation while moving forward towards improved energy security in the short as well as long term include:

- Strategic planning for imports to hedge against any possibilities of fuel supply disruptions and ramifications on the Indian economy.
- Demand side management to bring in reduction in energy requirements.
- Rational energy pricing to provide the correct signals to energy producers and consumers.
- Creation of enabling environment through regulatory changes.
- Integrated planning for energy in order to take a central approach to securing energy resources or technology from overseas.
- Public-Private partnerships to enhance investments in new technologies and set up additional capacities
- Greater regional co-operation with neighbouring countries such as Nepal and Bhutan to exploit the hydro potential

Conclusion : Challenging but Not Impossible!

One is therefore still hopeful. Energy availability at the global level may not be an issue, albeit choices may need to and are likely to change, driven by the preference of a cleaner environment and/or a changing techno-economic scenario which brings forth new ways to use fossil fuels in a cleaner manner and developments that harbinger new efficient and clean "winners". What is important therefore is for India to plan forward towards the transition to prevent energy and infrastructure "lock-ins", and strengthen the where withal of the system to absorb new technologies over the next few decades. From a technological perspective, alternative choices

are emerging and it is merely a matter of time that the paths that each of these options would traverse become clearer. India, just like any other country, should use the next few years in readying itself for a phase where alternatives can play a much larger role. Meanwhile, judicious use of the existing conventional resources, improvements in energy efficiency across sectors and efforts to secure fossil resources for the transition period are key to ensuring an energy secure development path.

Endnotes

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Regulating the Race to Renewables

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Regulators must focus on cost-effectiveness of public spending, through proper monitoring and evaluation and find ways to let the loser go. It is important to recognise the mistakes and withdraw state support to losing technologies before they become too costly. Moreover, considering the social obligations of a developing country and low affordability of Indian consumers, the regulators must make sure that high cost of RE does not make electricity service unaffordable to the poor (both connected and unconnected)

RENEWABLE ENERGY (RE) seems to be considered as a panacea for global climate challenge, while it is perceived to offer developmental co-benefits like energy security. Consequently, there is a race among nations to raise their respective renewable portfolios. More recently, investment on RE capacity addition has exceeded the investment on additional fossil-fuel based generating capacity addition worldwide. Global investment in RE has gone up from US$ 39.6 billion in 2004 to US$ 279 in 2011. Though it has dropped to US$ 244.4 billion in 2012, it is largely because of the drop in investment by developed countries and may be partly because of the drop in cost of RE technology. However, investment made by developing countries has been progressively increasing over years. In 2012, the gap between the developed and the developing economies in terms of overall investment shrunk to just 15 per cent. By end of 2012, at least 138 countries had set up RE targets. In early 2013, 127 countries had RE support policies in place, more than two-third of which are developing countries[1].

India's Approach and Aspiration

Keeping with the global trend, India has been an active player in the race to renewables, seeking to expand its RE portfolio. The country has set a target to raise its RE capacity to 74 gigawatt (GW) by 2022, including 20 GW of solar capacity, and procure 15 per cent of consumable electricity from RE sources by 2020.[2] With renewable installed capacity of about 30 GW, the country is already a global frontrunner. Over the 12thFive Year Plan period, it aims to install additional 30 GW renewable capacities with a federal outlay of around US$4 billion. The country has certainly set an ambitious target for RE development. The underlying objective is to achieve domestic energy security while attaining spin-off benefits like regional development, employment generation, globally competitive domestic industries, improved energy access and climate mitigation.[3]

India started its renewable energy program in 1981 with the establishment of the Commission for Additional Sources of Energy, with the responsibility of formulating policies and programmes, coordinating and intensifying research and development and ensuring implementation of government policies in regard to all matters concerning new and renewable energy sources. The Commission resulted in the creation of an independent Department of Non-Conventional Energy Sources in 1982, which was converted to

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an independent Ministry of Non-Conventional Energy Sources in 1992. In 2006, it was renamed as Ministry of New and Renewable Energy (MNRE). Besides, the Indian Renewable Energy Development Agency was established in 1987 to provide financial assistance for renewable energy projects, followed by creation of State Renewable Energy Development Agencies to implement projects at state level.[4]

India's existing RE development strategy prioritises wind and solar energy technologies. Wind energy has a major share in current and future development as the technology is well mastered and some of the major global manufacturers are based in India. Though solar technology has contributed less so far, it is expected to be the second contributor to India's RE portfolio by 2022 (See Table 1).

Considering limits of state capacity and resources, private sector will play a vibrant role in executing India's RE aspirations. In fact, much of RE development so far has taken place due to the private sector. Under the 12th Five-Year Plan, nearly one-third of the planned investment in infrastructure sectors has been earmarked for the electricity sector, about half of which is sought from private sector.

Proposed mode of private participation is an evolvement from the past experiences. Failure of public electrification and limits of market-first approach has forced the state to implement a partnership model, pairing the public sector with private sector. Even though the rhetoric remains that of market reformism, with actual implementation done by the private players, emerging electricity governance architecture seems to be a pragmatic hybrid with the state playing a stronger role of steering and guiding.

Given its role, the state seeks to promote RE development through market players by setting up a favourable policy environment, with complementary policies, incentive mechanisms and R&D support. India has adopted a unique approach to RE development by combining all the policy and regulatory drivers practised globally (See Table 2). It offers the RE producers feed-in tariffs, based on the cost of generation for each technology. Renewable Purchase Obligation (RPO) is a key policy to create demand for RE. Each subnational electricity regulatory commission has set a specific RPO for the utilities in respective states.[6] The Renewable Energy Certificate (REC) programme is being implemented to penalise the utilities who fail to meet their RPO; they have to compensate by purchasing equivalent RECs or pay a forbearance price. Furthermore, pursuing its aim to be a RE manufacturing hub, the state has employed policy instruments like Domestic Content Requirement (DCR), particularly for the solar, to support and promote domestic RE technology manufacturing industries.[7]

Stumbling Blocks

Are these policy initiatives enough to achieve India's renewable ambitions? These state initiatives are susceptible to failures and rent-seeking, which will affect India's energy security scenario as well as the development perspectives, let alone climate mitigation. Considering the current scenario, India's approach appears far from its RE aspirations.

Access to private finance is crucial for the development of RE industries, but current interest rates are too high and financing institutions remain reluctant to invest. Moreover, as many of the lenders are nearing the verge of their lending share for RE, they may withdraw from the market, restricting further project development.[8]The government does not yet have a comprehensive strategy so that RE developers can access money to invest.

At the same time, expected return on equity for the developers is significantly low in India as compared to other global leaders in RE. Although India has adopted market-based trading mechanism (like REC) and mandatory policy (like RPO), it has failed to attract investors due to low execution and participation in these schemes. Since its inception in March 2011, 1,22,44,174 RECs have been issued to 2,452

Table 1: Estimated Potential and Development of Grid-Connected Renewable Energy in India (in MW)

Resource	Estimated Potential	9th Plan (*Cumulative Achievement*)	10th Plan *Addition*	11th Plan *Addition*	12th Plan *Addition*	January 2014 (*Cumulative Achievement*)	13th Plan (*Anticipated Cumulative*)
Wind Power	1,02,500	1,628	5,464	10,260	1,965	**20,298.83**	40,000
Small Hydro Power	19,750	1,434	542	1,419	276	**3,774.15**	6,500
Biomass Power	23,700	389	795	2,021	467	**3,798.48**	7,500
Solar Power	20-30 MW/sq. KM	2	1	938	828	**2,208.36**	20,000
Waste to Energy	2,700	--	15	74	7	**99.08**	--
Total	**1,68,950**	**3,453**	**6,817**	**14,712**	**3,548**	**30,178.90**	**74,000**

Source: [Tripathi, 2013[5]; MNRE (www.mnre.gov.in)]

Table 2: Key Regulatory Policies in India for Promotion of Renewable Energies

Policies	Year of Enactment	Significant Features/Mandates
Electricity Act, 2003	*2003*	- Promotion of Renewable Energy by State Electricity Regulatory Commissions (SERCs). [Section 61(h) & Section 86(1) (e)]
National Electricity Policy	*February 12, 2005*	- Encouraging private sector participation. - Thrust on procurement of renewable energy through competitive bidding process. - Differential tariffs to promote non-conventional technologies.
National Tariff Policy	*January 6, 2006*	- Directions to SERC's for taking into account, availability of renewable energy resources in their region and its impact on retail tariffs, while fixing a minimum percentage for purchase of energy from such sources.
National Action Plan on Climate Change (NAPCC)	*June 30, 2008*	- Renewable energy procurement to be set at five per cent of the total grid purchase, which should be increased by one per cent each year for the next 10 years.
Policies on Renewables: A Report by Forum of Regulators & CERC	*November 2008*	- Uniformity in regulatory approach to clean energy development. - Promotion of co-generation and generation of electricity from renewable sources of energy.
Jawaharlal Nehru National Solar Mission (JNNSM)	*November 23, 2009*	- Enhance indigenous manufacturing capacity of solar energy. - 20 GW grid-connected and 2 GW off-grid solar capacity additions by 2022.
CERC Regulations on Renewable Energy Tariff	*December 3, 2009*	- Following a cost-plus approach in deciding the power purchase tariff. - Generation based incentives. - Sharing clean development tariffs. - 100% proceeds from CDM to be retained by the developer.
CERC Regulations on Renewable Energy Certificates	*January 2010*	- REC was introduced as a tradable commodity and the states deficient in renewable energy source can purchase the same to meet their RPO requirement. - Encourage competition to reduce costs.

registered RE generators, but only 63,54,206 RECs had been redeemed by April 2014.[9]Nonetheless, 22 out of 29 states failed to meet their RPO target set by their respective SERCs. Only seven states have achieved their RPO targets since 2009, while six states have zero per cent achievement. Whereas the national target for 2012 was to procure seven per cent of consumable electricity from RE sources, the cumulative achievement for the year was 5.01 per cent.[10] There is provision for forbearance price or penalty, but it is neither clear nor being followed. Moreover, national RPO target set under NAPCC is not coherent with the state RPO targets fixed by SERCs. Essentially, India lacks an effective compliance mechanism within the realm of RPO regulation, which may obstruct further RE development.[11]

Even when finance and compliance issues are addressed, lack of transparency in RE market can be a major barrier, impeding competitiveness in the sector. The lack of market transparency that prevails in the sector may result in rent-seeking and market distortion. A study by the Centre for Science and Environment reveals how a major conglomerate has subverted the rules to acquire a stake in the JNNSM that is much larger than legally allowed.[12]

Need for Regulatory Proactiveness

Most of these deterrents can be removed through proper monitoring, evaluation and impact assessments. Any country's ability to devote resources to RE development depends on its political-economic context, particularly national income level and perceived developmental co-benefits. For a developing country like India, that has to grapple with other developmental agendas, availability of external funding (private sector

investment and transfers from developed countries) would be a key driver for RE development. Although India has been able to adopt favourable policies with incentive mechanisms for RE developers, RE development is plagued by low execution of these policies. This calls for a stronger role to be played by the sector regulators. However, the role of regulators in facilitating RE would depend on the laws and policies established by the government.

While the existing policy instruments for RE promotion are being executed by the sector regulators, there is a need for their proactive engagement in monitoring, evaluation and impact assessment.Since the policies are not self-implementing, the independent electricity regulators would emerge as key facilitators (or blockers). The regulators have crucial roles to play in implementing these policies and would affect the pace and pattern of transition from a fossil-fuel driven electricity sector to RE based electricity sector.

Moreover, private participation will depend upon the extent to which private sector shares the state goals and the way they are organised and their capacity for collective action. At the same time, the state needs to build the confidence that private activities will be supported and rent-seeking will be avoided. Being apolitical institutions, the sector regulators can play a crucial role of an arbitrator and help to instil confidence among the private actors. However, to be an effective arbitrator, the regulators need to build their credibility and legitimacy of their decisions among the investors, utilities and consumers.

As discussed earlier, low level of transparency is a major hurdle in Indian RE market that promotes rent-seeking and affects competitiveness. The sector regulators must address it by ensuring real-time, credible and usable information dissemination through periodic progress reports that the stakeholders can trust. In that regard, the regulators must be authorised by the state to request information from relevant parties and receive appropriate response.

The governments are usually engaged in designing macro policies that cannot be expected to identify and address all micro issues pertaining to specific RE technology. In that case, it is the responsibility of the regulators to craft rules (or micro policies) while addressing specific cases or disputes as part of their regulatory functions. Though the issues associated with each RE technology varies, the regulators need not become specialists in each technology. Nevertheless, they need to be aware of the strengths and limits of each technology as policies are developed and employed.

Finally, the governments often tend to pick 'winners', by favouring a particular technology and make mistakes in selecting winners. The regulators must focus on cost-effectiveness of public spending, through proper monitoring and evaluation and find ways to let the loser go. It is important to recognise the mistakes and withdraw state support to losing technologies before they become too costly. Moreover, considering the social obligations of a developing country and low affordability of Indian consumers, the regulators must make sure that high cost of RE does not make electricity service unaffordable to the poor (both connected and unconnected).

Regulating the race to renewables will require creative manoeuvres and bundling of interests and policies, and may help to build private sector capacity and foster state-business relations. If successful, India could lay out a path for promotion and regulatory governance of RE in other developing countries.

Endnotes

1 However, as the sector has matured, there is an increasing trend of revisions to existing RE policies than adoption of new policies and targets.

2 The target includes only grid-connected RE capacity. However, India has separate off-grid RE targets, including two GW off-grid solar capacities by 2022.

3 *Swain, A. K. &Charnoz, O. (2012): 'India's Clean Energy Paradox', Business Standard, 7th December, New Delhi.*

4 *Charnoz, O. & Swain, A. (2012): 'High Returns, Low Attention, Slow Implementation: The Policy Paradoxes of India's Clean Energy Development', AFD Working Paper 125, Paris: AgenceFrançaise de Développement.*

5 *Tripathi, A. K. (2013): 'Three Decades of Renewables in India', AkshayUrja, 6(5&6): 10-17.*

6 The national target was set at 5 per cent for the FY 2009-10 and to be increased by 1 per cent for the next 10 years, with the aim to procure 15 per cent of consumable electricity from RE sources by 2020. The policy also makes a provision for solar-specific RPO set at 0.25 per cent in 2012 and to be raised to 3 per cent by 2022.

7 In the second phase of JNSSM, 50 per cent of the capacity addition is allocated for projects with DCR, where the developers are required to procure Indian made solar cells and modules.

8 *Nelson, D., Shrimali, G., Goel, S., Konda, C., & Kumar, R. (2012): Meeting India's Renewable Energy Targets: The Finance Challenge, San Francisco & Hyderabad: Climate Policy Initiative & Indian School of Business.*

9 Renewable Energy Certificate Registry of India, available at www.recregistryindia.nic.in, accessed on 07th April 2014.

10 *Greenpeace (2013): Powering Ahead with Renewables: Leaders & Laggards, Greenpeace India.*

11 Ascertaining the situation, recently MNRE has issued a letter to Ministry of Power (MoP) suggesting to make it mandatory for states to meet their RPO targets, in order to receive central assistance for financial restructuring of their discoms. However, MoP is yet to accept the suggestion. In July 2013, Maharashtra Electricity Regulatory Commission has directed all discoms to meet their RPOs in the past four years by March 2014, or else pay a stiff penalty.

12 Bhusan, C. &Hamberg, J. (2012): 'The Truth about Solar Mission', *Down to Earth*, 20 (16). ❑

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PROJECTIONS

Sustainable Electricity Supply for India

Narendra K Bansal

The problem can be overcome by exploitation of energy saving potential, which has been estimated as 25 per cent for the industry, 30 per cent in agriculture, 20 per cent in the domestic, 20 per cent in commercial, 20 per cent in transport and 20 per cent in other sectors. Full exploitation of these energy conserving potentials can reduce the future demand to 3080 bkwh reducing the demand and supply gap to only 50 per cent. This gap of 50 per cent can be filled by progressive utilization of nuclear, hydro, wind, solar and other renewable energy sources

India's population has grown in an extra-ordinary fashion standing at 1.21 billion in 2011, constituting 17.5 per cent of the world population. With trends continuing, the country is expected to reach a population of 1.6 billion (highest in any country of the world) with more than 500 people per sq. km. of the land area. In contrast, China's population will be 50 people per sq. km with much more energy resources at her disposal. Present installed electrical capacity of India is 223.344 GW; China has 1000 GW and plans to install 600 GW of clean energy, mainly through wind and solar, by 2020. Many coal power plants in India face acute coal shortages and future supply is not guaranteed. Present coal production of India is 550 million tonnes per annum, China mines close to 4 billion tonnes a year. India has to import 80 per cent of crude oil straining her foreign reserves. The main energy sources that are available in India are coal and thorium. Coal will remain the main energy source in India's energy supply chain. Technology to use thorium needs massive technology advancement and therefore may not be available in the next thirty years. Hydro potential is significant, but small compared to our needs and its contribution in terms of energy is likely to remain small. Further, the need to mitigate hydro environmental and social impact, often delays its deployment (Integrated Energy Policy 2006).

Coal energy reserves in India are at 286 billion tonnes and 41 billion tonnes of lignite. These resources are mainly confined to eastern and southern belts of the country. Crude oil and natural gas reserves are limited to 757 million tonnes and 1241 billion cubic meters respectively (Energy Statistics: Ministry of Statistics and Program Implementation, Govt. of India 2012).With respect to nuclear energy sources, available uranium can fuel only 10,000 MW pressurized Heavy Water Reactors (PHWR). India is dependent upon import of uranium to fuel her reactors.

Though India has major coal reserves, the annual production capacity is 553 million tonnes only. The production of domestic lignite and oil is 37.73 million tonnes and 37.7 million tonnes respectively. With 80 per cent of imported crude oil, the annual production of all petroleum products stands at 190.3 million tonnes and natural gas at 51.25 billion cubic meters (BCM).

Electrical Energy Scenario

Electricity, a higher quality form of energy is essential to all the

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sectors of the Indian economy. Since independence, the power sector has grown remarkably from 1.47 GW in 1947 to 223 GW by the end of 2013. Coal is the major electricity producing source supplying nearly 71 per cent of electricity followed by hydro (11.7 per cent), natural gas (7.4 per cent), renewable (6 per cent) and nuclear (3.4 per cent); annual electricity production being 963.7 bkWh. The respective plant load factors are relatively low with coal 58 per cent hydro 31 per cent, gas 19.8 per cent, nuclear 77.8 per cent and renewable 23.3 per cent. The reasons for low PLF are both technical as well as political. The transmission losses are 23.7 per cent against a figure of 9 per cent in the developed countries. Additionally, many states have not introduced power reforms and they prefer load shedding to supply of subsidized electricity for domestic and agriculture purposes.

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Sector wise electricity consumption shows growing contribution of the industrial sector which is at present 45 per cent followed by domestic sector 21 per cent, agriculture sector 18 per cent, commercial 9 per cent and others 5 per cent; total supply being 853 bkWh. Though agriculture employs about 50 per cent of the work force in India and contributes maximum to the Indian economy, its contribution to the total electrical energy supply has been proportionately decreasing since 2005 in comparison to other sectors. Total electrical energy consumption has more than doubled in comparison to its consumption in 2005; in the industry sector it has grown 129 per cent, 70 per cent in the domestic sector, 100 per cent in the commercial sector and 44 per cent in the agriculture sector. The trends are likely to continue because of desired growth of economy, which is likely to grow at 8-9 per cent annually. This will put further strain on the Indian power sector because of lack of conventional energy resources in the country and the Green House Gas emissions (CGHs) will correspondingly increase substantially because coal will remain our main supply source. Greenhouse gas emissions from the power sector contribute 65.4 per cent to the total emissions in the country. This is due to the dominant use of coal in our power sector.

Econometric modeling based on historical data suggests that electricity consumption will grow at a rate of 5 per cent to become 5000 bkWh in 2045 for BAU scenario; the industry, domestic, commercial and others (like services) will become dominant electricity use sectors; electricity consumption in the agriculture sector will grow very slowly relatively. In comparison to the demand, the electrical capacities will grow slowly. Domestic primary energy sources may not be able to meet this demand and there will be shortages of electricity in the business as usual scenario.

Reducing Demand through Energy Conservation

Prior to 2005, the Indian power sector was in bad shape with peak shortage of more than 25 per cent with electricity being used very inefficiently. The Ministry of Power estimated that there is a potential of saving energy between 20-25 per cent in various sectors of electricity consumption. In the year 2001, the Govt. of India enacted the Energy Conservation Act 2001. This act provides for legal framework, institutional arrangements and regulatory mechanism at the centre and state level to embark upon energy efficiency drive in the country. If full potential of energy conservation can be exploited, the electricity demand will reduce to 3080 bkWh in 2045, a decrease of nearly 40 per cent. Five major provisions of the EC act relate to designated consumers, standard and labeling appliances, Energy Conservation Building Code (ECBC), creation of institutional set up (BEE) and establishment of energy conservation fund. Various energy efficiency measures that have been promoted by the BEE since then are standard and labeling programme, demand side management, Energy Conservation Building Code (ECBC), Bachat Lamp Yojna, strengthening of institutional capacities of state designated agencies, state energy conservation fund, energy efficiency in SMSs and professional certificate and accreditation. The approach has

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yielded results with many industries lowering their energy consumption, availability of highly efficient products, use of CFLs (now LEDs) and many buildings that have low electricity consumption have been constructed. In fact, few buildings are either net zero energy buildings or net electricity producing by incorporating solar photovoltaic. The ECBC code is still not mandatory but the experience with ECBC compliant buildings has proven reduction in the connected load and electricity consumption by 30 per cent. Similarly, the agriculture pumps and many industrial drives have reduced their electricity consumption by 37 per cent.

Econometric projections of future electricity demand with the exploitation of full energy saving potential between 20-25 per cent shows that the total electricity demand in 2045 will reduce to

3080 billion kWh, in contrast to 5060 billion kWh without any energy conservation measures. The most electricity consuming sectors will remain industry, domestic, commercial and others in 2045. It is important to note that the agriculture sector which consumed 22 per cent of the electricity in 2006, shall account for only 4 per cent in 2045, while the commercial sector contribution will be 22 per cent and the others 18 per cent in 2045. In spite of all energy conservation potential resulting in reduced electricity consumption, the supply may fall short of demand and, new capacities have to be added to provide sufficient electricity for future growth as well as to take care of increasing number of consumers of electricity.

Renewable Energy: Future Electricity

With projected demand of electricity to grow fivefold, using coal will increase the emissions also four fold, a situation that is not sustainable. Moreover, this will require additional imports of coal also, which will make conventional power more costly. Hydro is of course another option; wind and solar energy systems when integrated with the present capacity, it is possible to meet the electricity requirements without straining our ecosystem. Econometric approach to possible sustainable power supply suggests that an immediate addition of hydro capacity by 10 per cent increase with annual addition of 5 per cent, 10 per cent of wind with 4 per cent annual increase, and 5 per cent solar with 1 per cent annual increase can meet the total future requirements of electricity.

In spite of all energy conservation potential resulting in reduced electricity consumption, the supply may fall short of demand and, new capacities have to be added to provide sufficient electricity for future growth as well as to take care of increasing number of consumers of electricity.

Wind power is already competitive with coal based electricity. The big coal power plants are signing the PPA with a tariff of Rs. 4.0/kWh while solar presently is Rs. 7/kWh. With imported coal on the rise to offset 10 per cent deficit (base load), the coal electricity cost may grow to Rs. 6/kWh without taking into account subsidies or cost of externalities. This does not begin to address the challenge of grid connected villages and many millions who don't have access to electricity. Domestic solar and wind power, in centralized as well as decentralized mode, can overcome the problems of GHGs emissions as well as improve the availability of power in remote locations or at places where grid electricity supply is poor.

Solar will be one of the main power sources, if we can address the following issues:

- Lower the costs of solar electricity bringing it down to Rs.5/ kWh or less in next couple of years. This requires improved efficiencies with the use of new materials and innovation in fabrication processes.
- Development and deployment of adequate and efficient storage systems
- Development of grid electricity in far flung and remote areas
- Replace grid connected or diesel operated pumps by solar for irrigation purposes.

Studies have proved that the life cycle cost of solar PV pumps is much lower than the liquid fuel based irrigation pumps (Kolhe et al 2002, Odeh et al 2006). The electricity from solar costs half of diesel generated electricity now, even when diesel is subsidized. This is because of the fact that solar PV has zero operational costs, requires low maintenance and almost no attendance. To reduce the demand of new electrical connections and subsidized electricity in the rural areas, Govt. of Rajasthan launched a Rs. 515 crore scheme in 2011 to provide subsidized solar irrigation pumps to 10,000 farmers in the state over a period of three years. Nearly 6000 pumps have already been installed in the state since then. The essential condition to avail 86 per cent subsidy on solar pump is that, the farmer should contribute 14 per cent of the pump and the rest paid to the technology provider for installing the pumps and maintaining these over a period of five years. There are three main advantages of installing solar pump to the farmer, namely, saving considerable amount of diesel, independence from grid electricity and efficient use of water. As a mandatory provision for availing the subsidy, the farmer has to use drip irrigation and he must construct a water reservoir. As per collected data, most farmers did not experience any difficulty in the operation of pumps (Kishore et al 2014).

If the solar irrigation pump programme is launched seriously, then all these PV systems can be used to produce electricity for lighting, ventilation etc to the neighboring households when the pumps are not being used. Provision of integrating electricity storage will also be a necessary requirement in that case.

Irrigation is however employed for a brief and limited period of the year and the solar panel remains unused for the rest of the period. If the solar irrigation pump programme is launched seriously, then all these PV systems can be used to produce electricity for lighting, ventilation etc to the neighboring households when the pumps are not being used. Provision of integrating electricity storage will also be a necessary requirement in that case.

Optimized Resource Allocation: MARKAL Projections

The allocations of resources, using econometric approach does not yield an optimized and rational allocation of energy resources. To get cost effective and optimized allocations, one has to resort to appropriate simulation models, where

the results of econometric model forecasting future demand can be used as input to the model. MARKAL (acronym for MARKet ALlocation) is a widely applied bottom-up, dynamic technique, and mostly a linear programming (LP) model developed by the Energy Technology Systems Analysis Program (ETSAP) of the International Energy Agency (IEA) [ETSP 2004]. MARKAL depicts both the energy supply and demand sides of the energy system. It provides policy makers and planners in the public and private sectors with extensive details on energy producing and consuming technologies, and it can provide an understanding of the interplay between the macro-economies and energy use. As a result, this modeling framework has contributed to national and local energy planning, and to the development of carbon mitigation strategies. The MARKAL family of models is unique, with applications in a wide variety of settings and global technical support from the international research community. Implementation in more than 40 countries and by more than 80 institutions, including developed, transitional, and developing economies indicates wide acceptability. As with most energy system models, energy carriers in MARKAL interconnect the conversion and consumption of energy. This user-defined network includes all energy carriers involved in primary supplies (e.g., mining, petroleum extraction, etc.), conversion and processing (e.g., power plants, refineries, etc.), and end user demand for energy services (e.g., boilers, automobiles, residential space conditioning, etc.). The demand for energy services may be disaggregated by sector (i.e., residential, manufacturing, transportation, and commercial) and by specific functions within a sector (e.g., residential air conditioning, heating, lighting, hot water, etc.). The optimization routine used in the model's solution selects from each of the sources, energy carriers, and transformation technologies to produce the least-cost solution subject to a variety of constraints. The user defines technology costs, technical characteristics (e.g., conversion efficiencies), and energy service demands. As a result of this integrated approach, supply-side technologies are matched to energy service demands. The user may identify which technologies should be considered as base load technologies by MARKAL i.e. those for whom operation must not fluctuate from day to night in a given season. The user may also specify the maximum fraction of night production that may be supplied from all base load technologies. Typically, nuclear plants and solid fuel plants are included in the base load set, since they can produce power consistently. The user may specify seasonal and even day-night limitations on the use of the installed capacity of some technologies. This is especially needed when the operation of the equipment depends on the availability of a resource that cannot be stored, such as Wind and Sun, or that can be only partially stored, such as water in a reservoir. The user may impose upper limits on emissions of one or more pollutants (in a region). The limits may be set for each time period separately, so as to simulate a particular emission profile (also called emission target), or in a cumulative fashion. By suitably naming emissions, the user may also separately constrain emissions from specific sectors. Furthermore, the user may also impose global emission constraints that apply to several regions taken together.

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In the case of Business as Usual (BAU) scenario, India has to add 750 GW of power plants by 2045 to meet the demand. 37 per cent of this addition should come from coal, 20 per cent from hydro and 18 from nuclear and renewable (mainly wind and solar). The BAU scenario does not offer any sustainable solutions because of increasing power plant capacities. It is essential for the country to implement energy conservation measures effectively that will allow only marginal increases from coal and hydro resources. Nuclear and renewable will be the main technologies for future additions in a cost effective manner.

In India, Pressurized Heavy Water Reactors (PHWR) are likely to remain the dominant nuclear technology because there is significant experience with design, construction and operation of these plants. In the present scenario, Advanced Heavy Water Reactor (AHWR) has been considered as an advanced nuclear power technology. AHWR is a vertical pressure tube type, boiling light water cooled and heavy water moderated reactor using ^{233}U-Th MOX (Mixed Oxide) and Pu-Th MOX fuel. MOX (mixed oxide) reactors were included in the model, since it is at least plausible that plutonium recycling would be considered in the future, despite the high costs and risks of proliferation.

The BAU scenario does not offer any sustainable solutions because of increasing power plant capacities. It is essential for the country to implement energy conservation measures effectively that will allow only marginal increases from coal and hydro resources. Nuclear and renewable will be the main technologies for future additions in a cost effective manner.

The Indian MARKAL includes the following nuclear technologies:

PHWR and AHWR. In the results that follow, the PHWR is presented as "conventional nuclear" and the AHWR presented as "advanced nuclear". Due to the long gestation period and some technical problems, the advance technology may be available only after 2020.

The only sustainable scenario is full exploitation of energy efficiency potential with renewable energy and advance nuclear from 2020 onwards. The energy consumption goes down after the year 2040.

Conclusions

Based on a mix model of time series and econometrics, it has been estimated that the electrical energy demand will grow from a present value of 660 bkwh to 5080 bkwh in 2045. Against this, the availability may only be 1520 bkwh. There could be a huge gap (70 per cent) between demand and supply. Supply of this amount of energy may be extremely difficult from the point of view of available resources. The problem can be overcome by exploitation of energy saving potential, which has been estimated as 25 per cent for the industry, 30 per cent in agriculture, 20 per cent in the domestic, 20 per cent in commercial, 20 per cent in transport and 20 per cent in other sectors. Full exploitation of these energy conserving potentials can reduce the future demand to 3080 bkwh reducing the demand and supply gap to only 50 per cent. This gap of 50 per cent can be filled by progressive utilization of nuclear, hydro, wind, solar and other renewable energy sources.

If full energy conservation potential (22 per cent) is exploited and implemented, advance nuclear technology starts making contributions from 2020 onwards. The total electricity demand starts decreasing after the year 2040, the CO_2 emissions also show a decreasing trend. Solar and wind energy based power plants will also have considerable power capacities added in the next 25 years.

In far flung areas or areas with load shedding, off-grid systems like solar pumps and micro grid based renewable energy systems can play an important role in supplying agriculture and rural house hold electricity requirements.

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A Comprehensive Assessment of India's Energy Sector

Ashok Sreenivas
Rakesh K Iyer

While some commonly discussed weaknesses of the sector such as increasing imports and the fiscal impact of subsidies get highlighted by the assessment, it also throws up some challenges ... These typically pertain to the low levels of energy access and consumption and the poor socio-environmental management regime in the country. These challenges need to be addressed expeditiously if the energy sector has to meaningfully contribute to the country's development

IT IS well-known that there is a close correlation between consumption of energy and levels of development. This is particularly true for countries at India's current level of development as can be seen from Figure 1.A small increase in per-capita energy consumption by India correlates strongly with a significant improvement in development levels, as measured by the UN's Human Development Index[1].

Therefore, it is important to assess and understand the strengths and weaknesses of the country's energy sector, so that policy formulation can be better informed. Typically, such assessment is done under the rubric of energy security and there is significant literature available on this. However, given the peculiarities of India, such as its high levels of energy poverty, socio-environmental stress and limited domestic fossil fuel resources, we believe it is important to adopt a more comprehensive and broader approach to assessing the country's energy sector. With this understanding, we developed a *multi-dimensional* assessment index for India's energy sector that considers the various aspects of the energy sector and its interactions with the country's social, environmental and economic structures.

Assessing the country's energy sector through this multi-dimensional index is similar to doing a comprehensive health check-up,which measures the various parameters of an individual's health, going beyond the obvious and immediate symptoms, to identify strengths and weaknesses. A further similarity to a comprehensive health check-up is that the energy sector assessment index also becomes more useful if it is performed periodically, as this will help to not only understand the 'snap-shot' view of the energy sector but also help to identify trends that can throw further insights. As a beginning, we have applied the methodology to compute the index for 2011-12.

The Energy Sector Assessment Index

Dimensions

Energy supply, distribution and consumption are not only correlated to human development, but also have social, environmental and economic impacts. To accommodate these various important, but somewhat different aspects, the proposed energy sector assessment index is multi-dimensional in nature and consists of the following five dimensions:

- **Demand dimension:** This dimension assesses the extent to which energy is enabling citizens to lead productive lives through its

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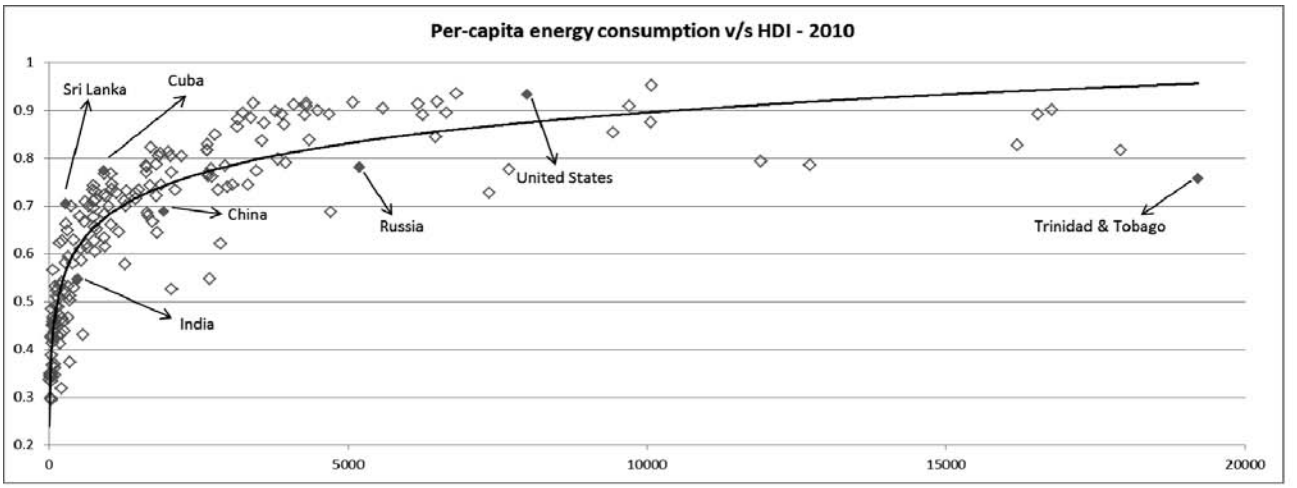
Figure 1: Correlation between per-capita energy consumption and HDI



use in households, enterprises and communities.

- **Supply Dimension**: This dimension measures the country's efforts at securing reliable supply of energy, and most closely matches a lot of work done in the energy security area.
- **Social Dimension**: Energy projects often require significant amounts of land, leading to displacement of citizens. Hence it is important to understand how well the country is rehabilitating those displaced by energy projects, and also the kind of development levels seen around energy projects. This dimension assesses these aspects.
- **Environmental Dimension**: Production, distribution and consumption of energy results in local environmental pollution in the form of air and water pollution, and contributes to climate change. This dimension assesses the environmental management status of India's energy projects from this point of view.
- **Economic Dimension**: Given rising energy costs and imports, it is important to use energy efficiently to power the economy and India's development. This dimension measures this aspect of the country's energy-economic system and also measures the impact of the energy price subsidies provided by India.

Assessment Methodology

For each dimension of the energy sector assessment index listed above, a hierarchy of elements is built ending with *indicators*, which have specific values. For example, indicators could represent India's energy access levels, import exposure, or subsidy levels. Figure 2 gives the complete hierarchy for the demand dimension, along with weights and indicators mentioned in bold. The energy sector assessment index has more than 30 indicators across the five dimensions.

Indicators are given values based on information available from official data sources, other published information or information sourced from responses to applications under the Right to Information Act. However, it should be noted that data is not easily available for all indicators. Therefore, some indicators had to be slightly modified based on data availability and values for some indicators had to be estimated or approximated using other proxies or based on values for other years. For example, data about usage of modern energy in rural non-farm enterprises (an indicator in the demand dimension) is only available for 1998-99 and 2004-05 and the value for 2011-12 was extrapolated from these values. Similarly, lack of official data about the resettlement and rehabilitation (R&R) of those displaced by energy projects forced us to rely on some research papers for data about a few energy projects. The full report gives details of all such approximations along with justifications.

Indicator values are then converted into scores in the range of 0 to 100 through a process of normalization, where global normative benchmarks for the scores of 0 and 100 are used to the extent possible. This makes most of the normalization straightforward – for example, percentage values are easily scaled up to the 0-100 range. For some indicators, such as energy intensity of the economy, there are no global normative benchmarks to represent 0 and 100. In such cases, an international comparison with the group of G-20 nations[2] is used, and India is scored based on its rank among the G-20 nations.

Scores for each level in the hierarchy are obtained through weighted sums of scores of its immediate descendants. Thus, the score for "Productive welfare impacts" in the demand dimension is a weighted sum of scores of "Productive impact on households", "Productive impact on enterprises" and "Productive impact on communities", while "Productive impact on enterprises" itself is scored as the weighted sum of scores for "Use of modern energy in rural agriculture" and "Use of modern energy in rural non-agricultural enterprises". In most cases, all the elements at a level in the hierarchy were weighted equally, except where

Figure 2: Hierarchy for the demand dimension

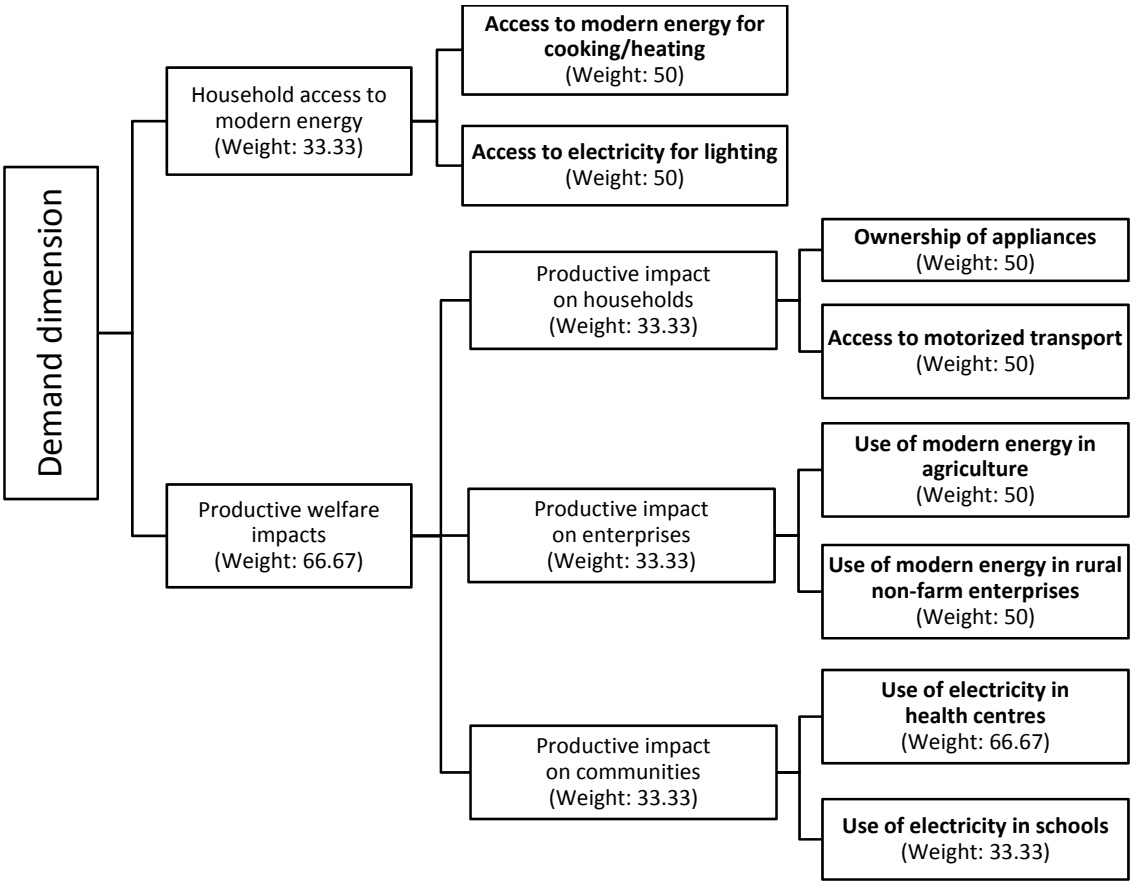
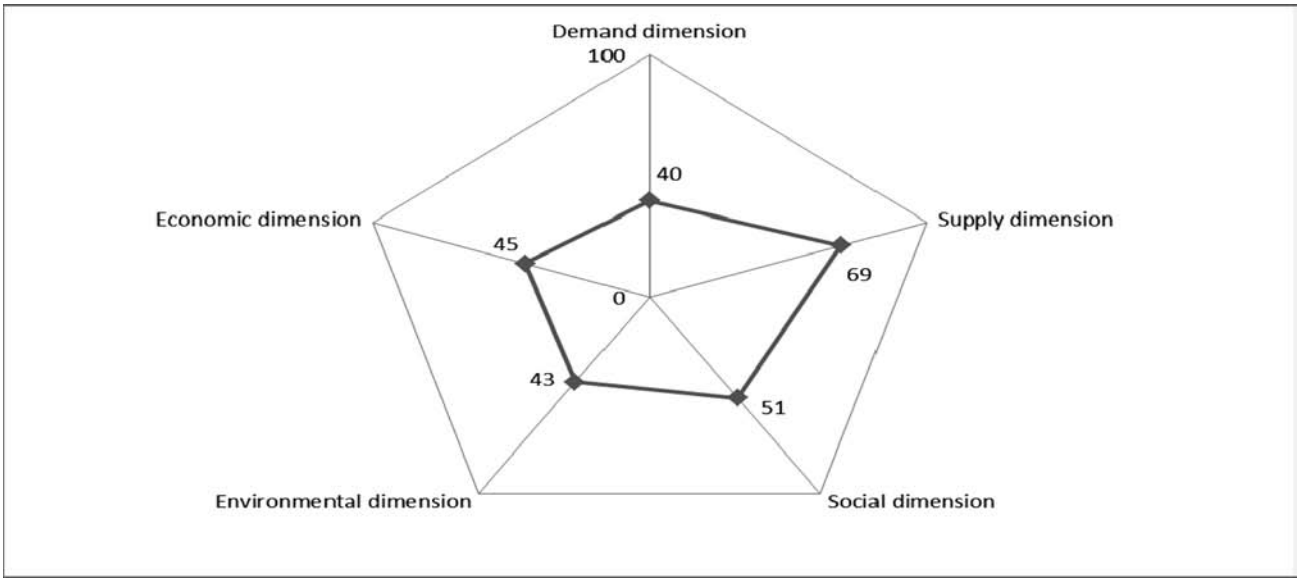


Table 1: India's Energy Assessment Index Scores for 2011-12

Indicator	Value	Unit	Worst value	Best value	India's score
Access to modern energy for cooking/ heating	29.06	per cent	0 per cent	100 per cent	29.06
Access to electricity for lighting	67.25	per cent	0 per cent	100 per cent	67.25
Household access to modern energy	Sub-dimension score				48.15
Ownership of appliances	59.20	per cent	0 per cent	100 per cent	59.20
Access to motorized transport	25.73	per cent	0 per cent	100 per cent	25.73
Productive impact on households	Sub-sub-dimension score				42.46
Use of modern energy in agriculture	0.2032	Pumps per farm holding	0	1	20.32
Use of modern energy in rural non-farm enterprises	27.38	per cent	0 per cent	100 per cent	27.38
Productive impact on enterprises	Sub-sub-dimension score				23.85
Use of electricity in health centres	35.70	per cent	0 per cent	100 per cent	35.70
Use of electricity in schools	47.11	per cent	0 per cent	100 per cent	47.11
Productive impact on communities	Sub-sub-dimension score				39.50
Productive welfare impacts	Sub-dimension score				35.27
Demand dimension	Dimension score				39.57

Figure - 3 : Indicator values for the Demand dimension



literature suggested that some elements were more important than others. Moreover, we confirmed that our framework was robust and not heavily dependent on the choice of weights, by performing a sensitivity analysis on the results of the assessment. The sensitivity analysis showed that dimension level scores changed by less than 5 per cent even if individual weights were changed by up to 50 per cent.

Results

We computed the energy sector assessment index for India for 2011-12 based on officially available data to the extent possible. However, data was either difficult to obtain or simply not available for some categories, typically related to socio-environmental impacts. In such cases, we relied upon responses to queries filed under the Right to Information Act for some energy projects and data available from some published literature. International data was taken from sources such as the World Bank and IMF. All indicator values were estimated using such data and based on the proposed methodology. These values were then converted to scores on a 0-100 scale and scores for all elements in the hierarchy were computed in a bottom-up fashion. Table-1 presents the scores for all the five dimensions while Figure-3 presents all the indicator values and scores for the demand dimension.

Key Findings

The assessment throws up some interesting insights about the state of the Indian energy sector.

Firstly, it is interesting to see that the dimension with the best score is the supply dimension (69) while the dimension that scores the worst is demand (40), with the environmental (43), economic (45) and social (51) dimensions not much further behind.

This is interesting because much of the popular discourse about the challenges facing the Indian energy sector tend to focus on supply-side issues such as pricing of energy discouraging investments in the sector, the tardy environmental clearance regime slowing down project development and India's growing energy imports and its implications. While some of these may indeed be genuine concerns, the scores suggest that the other dimensions deserve as much or more attention.

The scores on the demand dimension are low due to two factors:

1. About 40 crore Indians (well above population of US) lack access to electricity and about 80 crore Indians lack access to clean cooking fuels. This is the case even though it is 65 years since India achieved independence, about 30 years since India began its first 'clean cook stoves' program and 2 years beyond the deadline of 2012 for universal electricity access promised by the Ministry of Power in 2005. These low levels of access result in low scores not just for the access indicators but also for indicators such as inequality in consumption of modern energy.
2. Indian rural enterprises (both agricultural and non-agricultural) use too little of modern energy in the form of electricity, petroleum products etc. As a result, energy has not contributed sufficiently to improving productivity in these crucial sectors. This is probably because modern energy is either too costly or too unreliable or both.

While the demand dimension scores suggest that energy has not enabled people to lead productive lives, the scores on the social and environmental dimensions indicate that energy-related projects have played a disabling role in people's lives as the ill-effects of energy generation, transmission and consumption have not been suitably mitigated. This is illustrated by the following:

The scores for air and water pollution are a poor 30 and 0

respectively, with the score for RSPM concentration also being just 0. These indicate abysmal enforcement of existing pollution norms and poor environmental management of the energy sector.

India's score on providing compensatory R&R for those affected by energy projects is a modest 40, with the score for providing alternative livelihoods to those displaced being a poor 26, and the score for providing resettled households with access to health centres being an extremely poor 0.

The above points perhaps explain why energy projects, particularly large ones, frequently face grass-roots resistance. These scores indicate that those most affected by such projects seem to enjoy very few of the benefits arising from such projects but typically suffer significantly in the bargain.

India also scores poorly (28) on managing the financial impacts of the energy sector due to its energy imports forming a significant part of its trade deficit, and its energy subsidies as a share of GDP being quite high on an international comparison. The former in particular requires attention because the trend has been that India's energy imports have been rising faster than its overall GDP over the past decade, and many studies indicate that this is likely to grow significantly in the future. Addressing this requires India to improve its energy efficiency and exploit its domestic resources (both renewable and non-renewable) more efficiently, while also paying heed to the socio-environmental issues mentioned above. Its poor score on subsidies also indicates the need for a better targeted and implemented subsidy mechanism.

Interestingly, many indicators on which India scores well also hide some concerns. For example, the indicator for per-capita GHG emissions from energy is the only one where India scores a perfect 100. However, the reason for this good score is that India's per-capita primary commercial energy consumption is so low – a mere 470 kg-oil-equivalent (kgoe) compared to more than 2300 kgoe for the G-20 nations. Such a low consumption is consistent with India's low development levels and does not indicate high carbon efficiency. Similarly, the high scores for target achievement for electricity generation and fossil fuel production (around 84 each) are deceptive, because a shortfall of more than 15 per cent is much more problematic than a score of 84 suggests.

Finally, it should be mentioned that obtaining data for this assessment, particularly related to the socio-environmental aspects of energy, was very difficult. An objective assessment of the energy sector is not possible without the availability of such data.

India's energy imports have been rising faster than its overall GDP over the past decade, and many studies indicate that this is likely to grow significantly in the future. Addressing this requires India to improve its energy efficiency and exploit its domestic resources (both renewable and non-renewable) more efficiently, while also paying heed to the socio-environmental issues mentioned above.

Hence, there is a need for more robust, regular and comprehensive data collection mechanisms.

To summarize, an objective assessment of India's energy sector for 2011-12 shows that some of the major challenges facing the sector, such as very low levels of energy access and consumption, and very poor socio-environmental management, do not seem to get the attention they should.

Conclusions

Energy being one of the key inputs to socio-environmental development, it is important to objectively and comprehensively assess the sector. Towards this objective, we developed a comprehensive, multi-dimensional energy sector assessment index for India. This index should be computed periodically to assess the energy sector's strengths and weaknesses and to identify trends early so that policy interventions can be proposed to address the weaknesses and negative trends, if any. The index has been applied to India for 2011-12 to get an understanding of the strengths and weaknesses of the Indian energy sector.

While some commonly discussed weaknesses of the sector such as increasing imports and the fiscal impact of subsidies get highlighted by the assessment, it also throws up some challenges, arguably more important challenges, that are less known or understood. These typically pertain to the low levels of energy access and consumption and the poor socio-environmental management regime in the country. These challenges need to be addressed expeditiously if the energy sector has to meaningfully contribute to the country's development.

While the index has been developed specifically with India in mind, it is likely that it can be adapted and used for other developing countries, which perhaps face similar challenges.

(This article is based on a recently published report from Prayas (Energy Group) titled "A comprehensive, multi-dimensional Energy Index for India". The full report is accessible from prayaspune.org/peg/publications/item/270-a-comprehensive,-multi-dimensional-energy-index-for-india.html).

Endnotes

1. There is a similar correlation between other development metrics (such as, say, infant mortality) and per-capita energy consumption.
2. We consider 19 of the G-20 nations, i.e. Australia, Canada, Saudi Arabia, United States, India, Russia, South Africa, Turkey, Argentina, Brazil, Mexico, France, Germany, Italy, United Kingdom, China, Indonesia, Japan and South Korea, which together account for around 62 per cent of the world's population, 76 per cent of its annual primary energy consumption and 73 per cent of its GDP. The 'country' we do not consider is the European Union. ❑

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Household Energy Security

Shonali Pachauri

Decentralizing the provisioning of energy can be one way of increasing the energy security of households and communities. If done right, these solutions often rely on local renewable sources, and might even be a preferred option for a variety of reasons like local access to energy sources, savings on transport (of fuel) and reduction in costs of developing fuel supply and distribution chains, cleaner generation, boost to the local economy through job creation, etc.

THE INTEGRATED Energy Policy of India (2006) states "the lifeline energy needs of all households must be met even if that entails directed subsidies to vulnerable households. The demand must be met through safe, clean and convenient forms of energy at the least cost in a technically efficient, economically viable and environmentally sustainable manner". Yet, according to the 2011 Census, almost a third of all households or 400 million people in the country continue to live without an electricity connection. Even among those that are connected though, data from the 2004-05 Integrated Human Development Survey (IHDS) suggests that about 20 per cent receive less than 8 hours of supply in a day. Can we really say that these households are energy secure?

Furthermore, according to the 2011 Census, over two-thirds of all households or more than 800 million people continue to cook using solid fuels. A number of health and safety issues relate to cooking with solid fuels in traditional devices, most notably household air pollution, the risk of fires and burns, injuries associated with wood collection and carrying heavy loads, and the risk of attack or violence when collecting fuelwood. Cooking-related health and safety impacts mainly affect women and children since they have the highest exposure to smoke and the other risks connected to cooking with polluting fuels. The evidence is clear and compelling that the pollution from burning traditional biomass fuels in inefficient devices often in poorly ventilated conditions causes life-threatening and debilitating illnesses in its users, especially poor women and children who are regularly exposed . The World Health Organization's latest estimates suggest that in India alone, over a million premature deaths in 2010 can be attributed to exposure to household air pollution from solid fuel use. The time and effort expended in gathering biomass and carrying heavy loads has also been associated with back pain and headaches. Other risks associated with collecting biomass have also been reported such as snake bites, other injuries, and violence. The drudgery involved also leaves little time for those involved to engage in other leisure or productive activities that could earn them an income or secure them an education.

In addition to the many health and socio-economic impacts of using traditional solid fuels for cooking and heating, their use also produces significant quantities of 'products of incomplete combustion' (PIC),

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especially dangerous levels of fine particulate matter (PM2.5, PM10), carbon monoxide (CO) and nitrogen oxides, which have a higher global warming potential (GWP) than carbon dioxide (CO_2). When the biomass consumed is not sustainably harvested, the use of these fuels has the added disadvantage of no longer being CO_2-neutral. Extensive reliance on fuelwood can also lead to unsustainable harvesting practices that in turn contribute to degradation of soils and forest lands and generate other adverse impacts on local ecosystems. Biomass combustion is responsible for a significant proportion of carbonaceous aerosol emissions and brown clouds over the sub-continent. Recent evidence suggests that the warming effects of black carbon emissions, particularly for arctic and glacial ice, are larger than previous estimates have suggested.

Such a definition of household energy security includes several aspects. Physical availability includes a geographical dimension. In other words, the supplies should be available in proximity to where the household is located. Economic affordability requires that the energy be supplied to households at prices that even the poorest can pay.

From a household perspective, energy security can be defined in terms of access to secure, stable, and reliable supplies of modern energy at affordable prices in amounts adequate to meet demands for energy services in full so as to ensure human health and well-being in an environmentally sustainable manner. Such a definition of household energy security includes several aspects. Physical availability includes a geographical dimension. In other words, the supplies should be available in proximity to where the household is located. Economic affordability requires that the energy be supplied to households at prices that even the poorest can pay. Sufficiency or adequacy is harder to define as this may vary tremendously from region to region depending on climate, customs, and living standards. However, ensuring adequate energy for a healthy life implies that the types and amounts of energy should meet household needs for cooking, heating, and lighting at a minimum without adverse health impacts. Security from a household perspective also requires that supplies of energy be regular, reliable, and of standard quality, that is, uninterrupted and unadulterated.

However, the data from India and many other developing countries suggest that for many poor households energy insecurity is a fact of life. The energy needs of the poor are small, but even so supplies are often completely lacking or unreliable, and costs, especially of initial expenditures to assure connections or buy capital equipment needed to use more efficient energy sources, can be significant and constrain adoption. To secure reliable and continuous supplies of energy, households adopt a variety of coping mechanisms, one being the use of multiple fuels. Indeed, a dominant feature of energy use patterns in many developing country households is the tendency to use multiple energy–technology combinations. This may be due to cultural and taste preferences in some instances, but it also often stems from a rational decision to maximize energy security.

Complete dependence on commercially-traded fuels can leave households vulnerable to variable prices and often unreliable service. An analysis of energy-use patterns in Indian households using data from the NSS Household Consumer Expenditure Surveys suggests that most households report using one or more fuels to supplement their primary source of cooking energy. Dual or multiple fuel use is more frequent in poorer households that are more dependent on less efficient non-commercial fuels. Thus, rural and urban households reporting dung, firewood, or coal/charcoal as their primary cooking energy source are more likely to cook using other fuels as well. Households reporting their primary source of cooking energy as commercial fuels like (LPG) or kerosene are more likely to use only a single cooking fuel, perhaps because supplies of commercial fuels are easier to access, particularly in urban areas. Poorer households face greater uncertainty about their energy supplies. There are bigger seasonal variations in the biomass fuels on which they usually depend, and households are less likely to have access to more secure commercial fuel supplies, particularly in rural and more remote regions.

Traditionally, governments have also tended to heavily subsidize energy for poor households and agricultural consumers living in rural areas. While such subsidies may have been justified on social grounds, they have often resulted in market distortions, been appropriated largely by richer segments of consumers and led to state utilities and energy companies becoming bankrupt due to the heavy subsidy burdens.

Policies to address energy security concerns at a household level clearly need to ensure access to modern energy sources at affordable prices for all citizens. Increasing the physical availability of electricity and modern fuels requires increased supply and distribution of these energy sources. Both the public sector and the private sector have a role to play. The government, however, needs to provide the right incentives and regulations to encourage the private sector to invest in these sectors. In rural areas in many developing countries, the low demand densities and income levels make the supply of energy to these areas rather unattractive to private sector investors. Traditionally, governments have also tended to heavily subsidize energy for poor households and

agricultural consumers living in rural areas. While such subsidies may have been justified on social grounds, they have often resulted in market distortions, been appropriated largely by richer segments of consumers and led to state utilities and energy companies becoming bankrupt due to the heavy subsidy burdens. In the face of the increasingly poor financial performance of the energy utilities and companies, improving distribution to areas and households without access continues to lag behind. Innovative financial mechanisms and the development of appropriate business models are crucial to accelerate access for poor and rural segments of the population and to promote equitable social and economic development.

The current techno-economic paradigm for expanding access to modern energy services to all households neglects several important dimensions of the household energy security issue. In addition, while the government's policy for meeting energy demand through "safe, clean and convenient forms of energy at the least cost in a technically efficient, economically viable and environmentally sustainable manner," is commendable, the current emphasis on meeting a basic minimum or lifeline level of needs is sub-optimal. It focuses solely on energy for cooking, basic lighting, and minimal appliance use for domestic purposes (e.g. phone charging). This neglects other important service needs such as those for productive purposes and mobility. It also provides little incentive to integrate the provision of energy services within a broader livelihood enhancement and development agenda. Without encouraging productive uses of energy, modern energy provisioning or access can contribute to welfare improvements, but may do little to generate additional income for households, thus still leaving them vulnerable.

Decentralizing the provisioning of energy can be one way of increasing the energy security of households and communities. If done right, these solutions often rely on local renewable sources, and might even be a preferred option for a variety of reasons like local access to energy sources, savings on transport (of fuel) and reduction in costs of developing fuel supply and distribution chains, cleaner generation, boost to the local economy through job creation, etc. However, critical challenges persist in expanding decentralized solutions, not least of which are the high upfront costs associated with such options and lack of local capacity to install and maintain such systems. The Decentralized Distributed Generation (DDG) scheme under the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) and Remote Village Lighting Program are moves in the right direction. However, critical scale still needs to be built up to achieve the universal access goal and household energy security for all in India. ❑

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NORTH EAST DIARY

MEGHALAYA JOINS NETWORK OF INDIAN RAILWAYS

Meghalaya witnessed a historic feat on March 31 , when hundreds of people gathered to cheer as the Railway engine rolled out on Meghalayan soil for the first time from Dudhnoi –Mehendipathar Station Project line thus marking its inclusion into the Indian Railway Network. The Dudhnoi- Mehendipathar project is slated to connect Garo Hills in Meghalaya with Assam and the rest of the country which was first sanctioned in the Union Budget in 1992-93.This line will connect through Goalpara district of Assam from existing Dudhnoi station on New Bongaigaon-Goalpara-Kamakhya route of Rangia Division to Mehendipathar in East Garo Hills district in Meghalaya with 53 minor bridges, three major bridges, seven RUBs and two station buildings. ❑

TRIPURA GETS NINE ALL-WOMEN POLLING STATIONS

Nine all-women polling stations were set up by the Election Commission for the Parliamentary elections, keeping in mind the past performance of women polling personnel in Tripura. 19,000 polling personnel, including 60 women were deployed to conduct polling at 3,095 polling stations across Tripura. ❑

SIKKIM ADJUDGED THE BEST STATE IN HUMAN DEVELOPMENT

Sikkim has been declared the best state in Human Development according to the India Public Policy Report (IPPR) 2014, released by the Oxford University Press and Centre for Development and Finance, Jindal School of Government and Policy, According to the panelists, Sikkim had 100 per cent sanitation coverage and reported very few cases of diarrhoea. As per the report, health is directly connected to the coverage of sanitation. It also observed that the geographically smaller states did better than the larger states though they offered less job opportunities in contrast to the larger ones. The report was based on four indices namely social and livelihood opportunities, rule of the law and infrastructure, to analyse and rank the Indian states. This report seeks to aid policy advocacy and public policy effectiveness in India. ❑

Energy Security : From the Lens of Sustainability

Himanshu Gupta

...the relation of energy security and sustainability is complex, and that's why it is best recommended to ensure that any future strategy for energy security of India has implications on climate, water and food in a manner, which is sustainable for us in the long term

INTEGRATED ENERGY Policy (IEP)[i] of the Planning Commission defines the concept of Energy Security for India as "to provide lifeline energy to all its citizens irrespective of their ability to pay as well as meet their demand for convenient energy for citizens to satisfy their various needs at competitive prices, at all times, considering shocks and disruptions that can be reasonably expected". It further talks about exploring options for achieving India's Energy Independence beyond 2050. Two decades back, to an energy expert, Energy Independence would mean ensuring long term energy security for the country by exploiting domestic resources. However, in the current scenario, energy security is often described with its associated connotations on food, air quality and water security, or in short, sustainability.

This is why the Twelfth Five Year Plan aims at faster, sustainable and inclusive growth. A high GDP growth rate between 7-9 per cent in order to meet the aspirations of the rising population would mean high requirements of energy supply through fossil fuels: coal, oil and gas. India already imported 16 per cent of its coal requirement, 26 per cent of its gas requirement and 77 per cent of its oil requirement in the year 2011-12[ii], straining our fiscal position and making our economy vulnerable to geo-political shocks. For example, US-Iran stand-off on nuclear issues in the year 2013 affected our position on oil trade with Iran. Further, high levels of economic growth rates, as envisioned in the Twelfth Five Year Plan are bound to worsen our energy security, unless domestic fossil fuel reserves are exploited to satisfy these requirements. However, this is not recommended because of two reasons; firstly, the sufficiency of our domestic fossil fuel reserves to meet this requirement is questionable. Secondly, coal, oil and gas have high carbon footprints all along their value chain from mining to final combustion. Such rapid and high levels of exploitation of coal, oil and gas in the economy is unsustainable simply from an environment point of view. Inter-Governmental Panel on Climate Change-IPCC, unveiled its latest assessment report on March 31st 2014, which warns that India[iii], like many other countries may lose 1.7 per cent of its GDP if the annual mean temperatures rise by 1 degree Celsius compared to the pre-industrialization levels, hitting the poor the most. Such erratic climate patterns will cause droughts in some areas, affecting our food production, and flash floods in others as witnessed in Uttarakhand in the year 2013. Clearly, the sustainability debate calls for an integrated approach on food, water and energy security in the coming decades. Any miscalculated strategy on energy security might have irreversible impacts on our food and water security.

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In this context, future energy strategies for India in the long term can't remain dependent on fossil fuels, which currently dominate the primary energy supply mix. For example, coal met 46 per cent of the primary energy supply requirement in 2011-12. This requirement will almost grow to 50 per cent in coming decades going by the present policy scenario. This is a cause of concern because of two reasons. Firstly, India simply doesn't have enough coal to meet this requirement as our coal production will peak during 2037-2042 at a level of 1170 Million Tonnes per annum going by the present policy scenario. Secondly, coal is the biggest contributor to emissions, as it has the highest emissions factor and maximum usage in the Indian economy among the fossil fuels. India can't afford to have such high coal footprints in its electricity, industrial processes and other activities which require energy.

Thus, our strategy for a sustainable and an energy secure future should focus on phasing out use of fossil fuels from the demand sectors by electrification and in turn supply that electricity from clean sources of energy, which are developed domestically. However, clean sources of energy such as bio-fuels, solar, wind and even hydrogen are currently costlier and require risky investment decisions to be taken now, in order for these technologies to scale in the medium term and compete with conventional sources of energy. Another approach for a sustainable and secure energy future could be to introduce energy efficiency measures in all the energy demand sectors such as agriculture, industry, transport among others and cut down our energy consumption significantly. This strategy is also capital intensive, and would yield results only in the long term.

Investing in alternate energy sources or energy efficiency measures- any energy strategy for India-will have to be a judicious combination of these two, leading to thousands of pathways. All such pathways are laden with their own uncertainties regarding technology breakthroughs, policy decisions and global events. Additionally, all such pathways have their own implications on water, budgets and air quality. To help stakeholders understand this puzzle better, Planning Commission developed a tool called, India Energy Security Scenarios Tool, 2047 which quantifies millions of such pathways till 2047 and by which, aims to explore viable options for achieving India's Energy Independence by 2047, the 100th year of India's Independence.

One such pathway of this tool, the business as usual pathway[iv] states that India imported 31 per cent of its primary energy requirement in 2012 and this import dependence will further go up to 62.4 per cent or 16,998 TWh in energy terms by 2047 as shown in Fig.1. However, with aggressive investments in energy efficiency and with massive push for alternate supply technologies, this dependence could be brought down to 21 per cent or 4265 TWh by 2047. The pathway does rely on a number of assumptions on policy initiatives, technology breakthroughs and pricing reforms. However, within various financial and political constraints that the country has, it becomes equally important to prioritize our investments, and incentives towards those sectors and technologies which can maximally contribute to our energy security. Thus, it is worthwhile to look at relative potential of energy demand reduction within each demand sector in this pathway as presented in Figure-1.

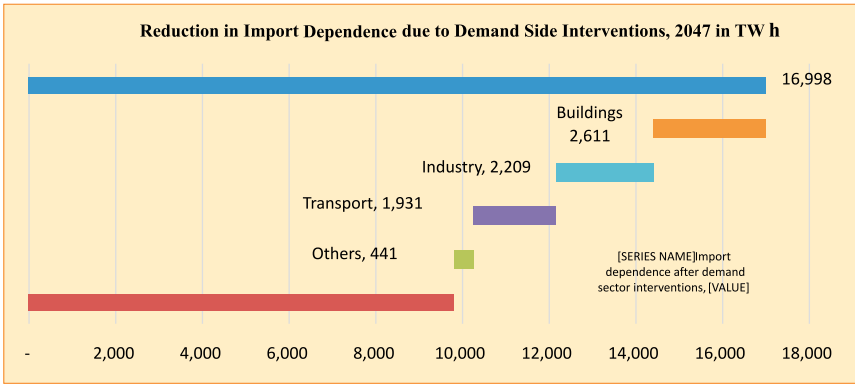

Fig.1 *Energy Demand reduction potential in TWh of Demand Sectors by introducing measures of energy efficiency.*

Clearly, buildings, industry and transport could reduce the import dependence by 15 per cent, 13 per cent, and 11 per cent by 2047 respectively if sufficient energy efficiency measures are introduced in all these sectors now. For e.g. in transport sector, policy prescriptions should aim at increasing share of rail both in the passenger and freight transport segment, should incentivize use of public transport for road travels and support roll out of electric vehicles to an extent of 35 per cent of four wheeler segment by 2047. In fact, policy should holistically aim at maximal electrification of freight as well as passenger movement within transport sector. Similarly, in industry, successful implementation of Profit Achieve Trade (PAT) scheme of Bureau of Energy Efficiency will be instrumental in incentivizing industries to move towards energy efficient processes and further use clean fuels to power those processes. In the buildings sector, creating market mechanisms for higher penetration of LEDs, and five star rated appliances in the commercial as well as the household segment will put India onto a trajectory where we could target 21 per cent import dependence or lower by 2047.

As stated earlier, that by being aggressive in the demand sectors alone and by ignoring supply sectors can rarely help us attain the twin objectives of a secure and sustainable energy future. A similar analysis conducted for the supply sector reveals the relative contribution that alternate supply side technologies could make to our Energy Independence as presented in Fig. 2.

Fig.2 reveals that by exploiting our domestic reserves of coal, oil and gas, we could bring down our import dependence by 12 per cent, 5 per cent, and 1 per cent respectively from the levels of 16998 TWh of import dependence in 2047. This requires intervention on policy, technology and

pricing fronts among others. For e.g. single window clearance mechanism to incentivize investments and production from captive coal blocks will be instrumental in increasing our domestic coal production and reduce our coal imports. Additionally, market pricing for fuels such as gas will not only enable fresh investments into the existing gas fields but also push private sector investments in unconventional fossil fuel sources such as shale gas, shale oil and gas hydrates. It is worthwhile to mention that gas is the cleanest among the fossil fuels-with emissions almost half of the emissions from coal. However, alternate technologies such as 2nd Generation Bio-Ethanol, Algae based Bio-diesel, will play an equally important role in meeting the ever increasing demand for oil in the transport sector and can reduce our import dependence by 11 per cent. Bio-Energy Mission, if announced in the near term can very well provide the push along pricing, technology and market mechanisms in an integrated fashion to realize this objective. Similarly, smart grid investments in our transmission and distribution alone can bring down our import dependence by almost half as much as the increase in exploitation of domestic gas reserves.

The analysis presented above is based on scenarios approach adopted by the Planning Commission. The bigger challenge of ensuring energy security in a sustainable manner is to recognize the right policy levers

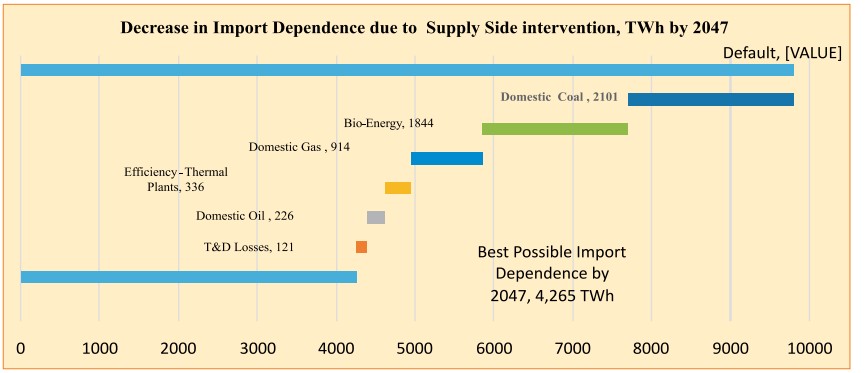

Fig.2 *Carried forward from fig 1- Potential contribution in TWh of various supply side technologies towards reducing Import Dependence by 2047.*

that will put India onto a trajectory as presented in the analysis above. The consequences of not doing the same are visible even now wherein the latest report of IPCC[v] states that rice productivity in the Indian belt could be impacted by 7 per cent for every one degree rise in surface temperatures. The report strongly links this likely event to the consequence of increase in global emissions arising out of human activity, posing questions of food security for a country of billions. Thus, the relation of energy security and sustainability is complex, and that's why it is best recommended to ensure that any future strategy for energy security of India has implications on climate, water and food in a manner, which is sustainable for us in the long term. In the words of Mr. Montek Singh Ahluwalia, Deputy Chairman, Planning Commission[vi], "if the energy needs of the country are to be met in the long term in a manner consistent with rapid and inclusive growth and also sustainability, there needs to be much greater understanding of the choices involved and the polices they imply for all the stakeholders."

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J&K WINDOW

E-GOVERNANCE FOR J & K TOURISM

The Directorate of Tourism, Kashmir launched its first e-governance web portal (www.kashmironlinetourism.org) to grant new registrations as well as renewals of the already issued registrations for Hotels, Guest Houses, Houseboats, Travel Agencies, Restaurants, Tour Operators etc. This initiative of e-governance has been brought in to bring better transparency in the system, deliver a hassle free and timely tourism services to the stake holders and also to check the process of issuance of fresh and new registrations. To avail this hi-tech facility, all the stakeholders who are concerned with this trade will have to register themselves with the Department of Tourism under the Tourist Trade Act.

SRINAGAR TO GET ONLINE AIR POLLUTION MONITORING SYSTEM

Srinagar, having the highest level of air pollution due to increasing number of automobiles and other vehicles, will get the first online air pollution control monitoring system, to facilitate better controlling of the air pollution levels providing better health benefits to the local people. This online system will help in keeping the people better aware and updated about the presence of various air pollutants like dust and carbon particles and different polluting gases in the atmosphere at different places. In addition to this ,it will also aid the Pollution Control Department to take measures to curb the same by employing a digitized air pollution control device. With its help, the people can get the information about the level of air pollution about their destination that can help them to avoid the places with high levels of pollution and hence, contribute to good health. Since the pollution levels reduce in winters, this project will be functional by next year for which an amount of Rs. 1.10 crores has been earmarked. This project is expected to be more fruitful and beneficial through people becoming more aware about their environment.

The Trajectory of Financial Reform in India

K P Krishnan

When a variant of the Indian Financial Code is enacted as law, it will constitute a long-term solution to the problem of establishing a capable financial system. The law and the regulatory agencies are likely to serve India well in the next three doublings of GDP, from $2 trillion to $16 trillion, which are likely to take place in the coming 30 years

THE DEVELOPMENT of fiscal, financial and monetary institutions is central to the process of economic reform. When India was a less developed country with a GDP of $250 billion, these issues were less pressing. As India emerged into middle income, with a GDP of over $1trillion, and with increasing integration into the world economy, these issues have become much more important. Weaknesses in fiscal, financial and monetary institutions have led to macroeconomic and financial crisis in many countries, and India now needs to focus on establishing and strengthening institutions that are in step with the requirements of the economy.

The three components-fiscal, financial and monetary-are often viewed as separate. The laws governing these are distinct. The agencies that perform executive functions are distinct, and there are distinct groups of experts on each of them. However, there are deep interconnections between all three aspects. Sound outcomes on each of the three fronts require sound foundations on the other two fronts. Hence, there is a need for a consistent strategy spanning all three aspects. Clear thinking about economic reform needs to fully understand the rich inter-linkages between all three fronts.

The reforms of 1991 reflected a combination of economic policy vision, response to a crisis, and political economy. The fiscal crisis and balance of payments crisis, and the IMF program, had created a consensus that fiscal, financial and monetary policy had to be done differently. The Harshad Mehta scandal, which involved the bond market and the equity market, generated an opportunity for policy and institutional reform. Domestic industrialists were keen to have foreign investment in their shares and bonds, but this process was impeded by the problems of the Bombay Stock Exchange. These factors came together to give a burst of reforms.

New work began in a series of areas. An improved exchange rate regime was established. Capital account liberalisation was undertaken. Micro-prudential regulation of banks was improved. The government signed the `Ways and Means Agreement' with RBI through which monetisation of the deficit was curtailed.

All these were incremental changes. The biggest change of that period was the reform of the equity market. The National Stock Exchange (NSE) and the National Securities Depository (NSDL) were established. The erstwhile Controller of Capital Issues (CCI) within the Ministry of Finance was closed down. The SEBI Act was passed in Parliament, and the new regulatory body, SEBI, was created. From the period 1992 to 2001, fundamental change in the equity market was obtained.

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Alongside this, change was taking place in insurance (with the creation of IRDA and the entry of private insurance companies) and pensions (with the establishment of the New Pension System). All these changes added up to important progress in financial reforms.

With all these developments in hand, there was a natural stage of generalisation where successful ideas from one sector could be applied into other sectors. As an example, a general strategy for trading on exchanges was in hand, owing to the reforms of the equity market. This could potentially be applied into other areas such as trading in currencies or bonds or commodities. The contrast, between a successful equity market and a failed bond market, was increasingly apparent. Similarly, the New Pension System brought about new ways of thinking about consumer protection: this had implications for how we think about mutual funds or insurance companies.

This suggested a next stage of reforms grounded not just in one sector but at the level of the overall financial system. The way for this was paved through a series of expert committee reports.

Percy Mistry led an expert committee focused on international finance in 2007, and on India's future in exports of financial services. This committee was initiated by the Ministry of Finance, and was the first expert report which looked at the financial system as a whole. Raghuram Rajan led an expert committee focused on domestic finance in 2008. This committee was initiated by the Planning Commission. U. K. Sinha led an expert committee that reviewed capital controls in 2009. This was initiated by the Ministry of Finance. This was the first report which emphasised problems of regulatory governance and the rule of law. Dhirendra Swarup led an expert committee in 2009 that looked at problems of consumer protection with insurance and mutual fund products. This was initiated by the Ministry of Finance. This report set the stage for more general thinking about consumer protection on the scale of the entire financial system.

All these committees shifted the discourse from thinking about one sector at a time, or one regulator at a time, to thinking about the entire financial system. They raised difficult questions about how the work allocation between government agencies needed to be modified, and the opportunities to utilise successes in some areas to transform other areas.

These four committees were new in one more respect: there was a strong representation of experts and of the private sector. This was generally in contrast with the committees which had been constructed prior to 2007 (with the exception of SEBI's L. C. Gupta Committee of 1997). All four committees were supported by strong research staff, none of which were drawn from within existing government organisations. All four committees stood on the shoulders of the within-sector successes of financial reform which had come before. They benefited from improved skills and reduced conservatism through committee composition and the research teams which supported them. Over 100 individuals were involved in these four committees, in various capacities. This helped give four important reports, which created an internally consistent consensus about the broad direction for financial reforms.

... large parts of this strategy for change was incompatible with existing laws. As an example, all expert committees have recommended a unified treatment of organised financial trading on all kinds of products, such as equities, bonds, currencies, commodity futures, etc. However, each sub-component is presently the subject of separate laws and agencies giving a fragmented set of laws and regulatory agencies.

The four reports, put together, had a coherent strategy for change. Many specific recommendations were implemented in the aftermath of the reports. However, large parts of this strategy for change was incompatible with existing laws. As an example, all expert committees have recommended a unified treatment of organised financial trading on all kinds of products, such as equities, bonds, currencies, commodity futures, etc. However, each sub-component is presently the subject of separate laws and agencies giving a fragmented set of laws and regulatory agencies.

As a consequence, the Ministry of Finance established the Financial Sector Legislative Reforms Commission (FSLRC), chaired by Justice Srikrishna. This was given the mandate of comprehensively examining all existing financial laws, and replacing all existing laws by a single internally coherent and modern law. This new law has been titled the `Indian Financial Code' (IFC). In March 2013, the FSLRC submitted its report and the draft Indian Financial Code. FSLRC's work is the first time that a comprehensive cleanup of the laws in one field has been undertaken. FSLRC was a commensurately large project, reflecting the complexity of the task. The Commission worked for two years, and was supported by a dedicated 30-man research team at NIPFP. A total of 146 persons were involved in the work, thus ensuring that diverse viewpoints and skills were brought into the work. FSLRC has done important new work in the field of administrative law, of clarifying the legal arrangements for public bodies which are outside of government. It approaches all these bodies from the viewpoint of objectives -powers-accountability mechanisms. For each body, it seeks to write down precise objectives. The minimum set of precisely defined powers are given to the agency in order to pursue these objectives. An array of accountability mechanisms is established in order to create checks and balances which generate sound institutional capability on a sustained basis in a depersonalised way.

A key element of the objectives is a focus on market failures. In previous decades, Indian economic policy involved large-scale public interventions in the working of the market economy. This needs to be replaced by a focus upon addressing market failures: the situation where the working of the free market generates mis-allocation of resources.

In finance, there are four kinds of market failures: consumer protection, micro-prudential regulation, systemic risk regulation and resolution. The draft IFC features a detailed treatment of objectives-powers-accountability for each of these four areas. At the same time, this is done in a non-sectoral way. Consumer protection in the IFC is written with a focus on the consumer. The identical sections of law apply for banking or insurance or any other kind of financial service. This ensures consistent regulatory treatment of the entire financial system. It also avoids the corrosive political economy problems where firms in each sector lobby for weaker regulation and weaker laws in order to obtain greater profits.

The IFC envisions that there will be seven organisations outside the government:

1. The RBI will do monetary policy and regulation of payments and banking.
2. A new body, the `Unified Financial Authority' (UFA) will do regulation of all other parts of finance. This will involve a merger of SEBI, IRDA, PFRDA, FMC, and some components of RBI.
3. A new body, the `Resolution Corporation' (RC) will identify weak financial firms and close them while protecting the interests of unsophisticated investors.
4. The existing FSDC will do systemic risk regulation and development.
5. A new body, the `Public Debt Management Agency' (PDMA) will do investment banking for the government, taking over a role that is at present performed by the RBI.
6. A new body, the `Financial Redress Agency' (FRA) will be a one stop shop for consumers who have disputes against financial firms.
7. The existing Securities Appellate Tribunal (SAT) will be upgraded into a Financial Sector Appellate Tribunal (FSAT) and hear appeals against all regulatory actions in finance.

This modified regulatory architecture avoids conflicts of interest, and harnesses economies of scope and scale for public bodies and for the private sector. Each of the seven organisations has a clear purpose, which generates enhanced accountability.

...the FSDC has made important progress in the nature of identifying improved mechanisms of regulatory governance and administrative law from the IFC, and voluntarily adopting them across all existing financial agencies. The implementation of these reforms, which will take place over the coming year, will yield significant improvements in the quality of work and the rule of law at all existing financial agencies.

The draft Indian Financial Code is now a proposal that is before the Ministry of Finance. In the future, a modified version of it may be enacted as law. However, without its being enacted, the FSDC has made important progress in the nature of identifying improved mechanisms of regulatory governance and administrative law from the IFC, and voluntarily adopting them across all existing financial agencies. The implementation of these reforms, which will take place over the coming year, will yield significant improvements in the quality of work and the rule of law at all existing financial agencies. When a variant of the Indian Financial Code is enacted as law, it will constitute a long-term solution to the problem of establishing a capable financial system. The law and the regulatory agencies are likely to serve India well in the next three doublings of GDP, from $2 trillion to $16 trillion, which are likely to take place in the coming 30 years.

Many elements of this experience are relevant in other aspects of economic reform in India. At the level of ideas, it is useful to focus government bodies upon market failures, endow them with precisely stated powers that are required for addressing market failures and set up an array of accountability mechanisms. In many areas, it is important to get away from narrow considerations to greater generality. As an example, there may be value in thinking of energy as a whole instead of thinking about coal and electricity as separate sectors. There may be some applicability of the process adopted in financial reform into other sectors: of first building a group of committee reports that forge a consensus, and then establishing a group to redraft the laws, while at all times ensuring adequate technical expertise supporting the committee. ❑

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Removal of Rural Poverty

L C Goyal

Inclusive growth and removal of rural poverty are the two sides of the same coin. Elimination of poverty is achievable. I look at the glass being half full and not half empty. The direction that we need to take, and the effort that we need to make, is how to make the glass full through concerted action in collaboration with all stakeholders including CSOs

REMOVAL OF basic rural poverty in the country is no longer a rhetoric or a slogan. It is certainly doable. How it is so is enunciated here. In the last few years, poverty levels in rural areas have come down to 25.7 per cent in 2011-12 at a relatively faster rate than before. Also, the rural landscape has witnessed a rapid transformation. Rural wages have increased at about 20 per cent every year in recent years. While agriculture remains at the heart of rural livelihoods, there is a growing shift to non-farm employment. As per latest NSSO data, the work force engaged in agriculture has declined below 50 per cent for the first time. As more men move towards non farm jobs outside the village, there has been a feminisation of agriculture.

Anti Poverty Strategy

There has been a high GDP growth rate over the past decade at 7.3 per cent, on average, per annum between 2001 and 2010. We should all feel proud of this achievement. We should also be equally aware of the fact that there are still a huge number of people in rural areas who are below poverty line, given the gigantic size of population of our country. In a low income country like ours where income inequalities are rising, and there are wide variations in socio-economic indicators across and within States, high economic growth and distribution or social development need to go hand in hand. Both are complementary to each other. This is a two way relationship as is rightly articulated by Jean Dreze and Amartya Sen in their Book 'An Uncertain Glory - India and its contradictions'. In our context, therefore, this is an imperative and not an option if the goal of 'inclusive growth and removal of rural poverty' is to be realised.

Keeping this backdrop in view, the vision of the Ministry of Rural Development is sustainable and inclusive growth of rural India aimed at eradicating rural poverty. The estimate is that there are 8 to 10 crore rural poor and vulnerable households spread over 2.5 lakh Gram Panchayats in more than 630 districts of the country. Of these, the bottom 25 per cent of the households need special attention. To realise the vision of inclusive growth, the Ministry is credited with mainly four flagships programmes that comprise a multi-pronged anti-poverty architecture and strategy of (i) increasing livelihood opportunities, (ii) developing infrastructure for socio-economic growth, (iii) improvement of quality of life, and (iv) providing social safety-net to as many households as possible. These consist of Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA), National Rural Livelihood Mission (NRLM), Pradhan Mantri Gram Sadak Yojana (PMGSY), Indira Awaas Yojana (IAY) and National Social Assistance Programme (NSAP).

PMGSY

PMGSY aims at rural connectivity. Rural connectivity is a critical component

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in socio-economic development of rural people as it provides better access to amenities like education, health besides strengthening of rural livelihood base. The contribution of rural connectivity to poverty reduction has been very significant. This scheme has been very successful. Over the last 13 years, nearly half of the eligible unconnected habitations totalling 94,767 habitations have been connected with a total length of 3.82 lakh Kms. Rural connectivity alongside electrification and tele-density have proved to be big productivity enablers in rural areas.

IAY

Provision of shelter contributes very significantly to the family's dignity, self-esteem, security and socio-economic development. IAY is a public housing scheme for rural BPL families. Since inception, 3.2 crore families have benefited under this intervention. In the 12th Plan, the target has been scaled up to 30 lakh houses per year.

MGNREGA

MGNREGA provides guaranteed unskilled wage employment to willing rural households through creation of durable community and individual assets that provide sustainable incomes. It is a unique programme both in terms of its scale and delivery mechanisms. Every year, on an average, 230 crore persondays are generated, 5 crore rural households and 9 crore adults are given guaranteed employment with about half of them being women and another half coming from Scheduled Caste and Scheduled Tribe categories thereby constituting a massive exercise at social inclusion. Close to Rs. 40,000 crore is being spent on the programme every year, almost entirely by the Central Government.

Various studies have shown that MGNRGA has provided a resilient safety net especially in lean periods, it has reduced distress migration to other rural/urban areas, enhanced the value and opportunity cost of rural labour, strengthened or regenerated the natural resource base such as land, soil, underground and surface water sources, irrigation, forests, environment, etc., in rural areas, led to significant socio-economic empowerment of women and strengthening of local level democratic institutions (PRIs). The programme has also led to unprecedented financial inclusion. Nearly 9 crore bank or post office accounts have been opened in the name of beneficiaries thereby bringing them into the organised sector.

MGNREGA has become a powerful instrument of inclusive growth. It has enabled both livelihood security and social development. It has significant positives that merit to be appreciated and highlighted, while any one should welcome honest criticism. There are issues of delay in payment of wages and lack of adequate technical staff that need to be addressed. Increased focus is also necessary on creation of durable and quality assets through sustained convergence with other government programmes and schemes. Social audit has to be on a bigger scale to induce greater accountability, efficiency and transparency in implementation of the programme.

National Rural Livelihood Mission (NRLM)

NRLM is a unique programme aimed at removal of rural poverty through universal social mobilisation of rural poor households into self-managed and sustainable institutional platforms of the poor. Its core belief is that the poor have innate capabilities and a strong desire to come out of poverty. Ground level experience has shown that these latent capabilities in each poor person can be unleashed when the poor are organised, supported, nurtured and capacitated through knowledge, skills and information, and provided continuous access to resources. The best institutions to do this are the institutions of the poor women themselves. NRLM has a model based on more than two decade long experience of state-wide coverage in certain States such as Andhra Pradesh, Kerala and Tamil Nadu and the work of dedicated civil society organisations (CSOs) across the country. The basic strategy of NRLM is that that all the key processes are driven by the institutions of rural poor women, especially by women who have come out of poverty and whose lives have been transformed by this very process. Thus, it is a programme for the poor, of the poor and by the poor.

NRLM builds community leaders from among the poor women and leverages the services of such women, who have come out of poverty, to take their own learnings and success stories to neighbouring villages, blocks and districts and even to other States. These women leaders known as Community Resource Persons (CRPs), enable scaling to happen in a very organic manner without losing quality. They also make the process sustainable and self-managing. I have had a few interactions with some of these women. There are about 1,500 CRPs majority from Andhra Pradesh and also from Bihar currently working in 7 different States (and four other States are in the pipeline) including in difficult areas like Jammu & Kashmir and Naxal affected States such as Chhatisgarh, Jharkhand, etc. They are engaged in relating their own experiences to poor women in these States and motivating them to join SHGs besides creating internal (local) community resource persons. After listening to their experiences, I told them that 'the work that I have been doing in the last 34 years of my service is nowhere near the excellent work you are doing. You are the real community leaders or change agents'.

NRLM has proved to be a cost effective programme. The financial support from the government is only to the extent of Rs 15 crore per block in a span of 10 years. Effectively, it works out to just Rs. 12,000 per rural household over this period. Even out of this investment, almost Rs. 8,000 in the form of seed capital, remains with the self-help groups and their federations as 'a resource in perpetuity'. This investment is expected to leverage at least 8 to 10 times the amount in terms of institutional credit.

NRLM also has the important component of Mahila Kisan Shasktikaran Pariyojana (MKSP) to encourage modern agricultural practices among women farmers with active involvement of civil society

organisations. Placement-linked Skill Development through Public Private Partnership (PPP) is yet another component of NRLM.

NRLM, launched in 2011-12, is a new and a smaller scheme. It has tremendous in-built flexibility. In my view, it is most central, and potentially the most significant, in our fight against rural poverty. The programme aims to reach out to all rural poor households in the country estimated at 8 to 10 crore and, more importantly, stay engaged with them for a period of 10 years, and help them through each household based micro-investment plans to graduate from their current unviable and risky livelihoods to more viable and sustainable livelihoods and thus come out of poverty. This would mean creating and strengthening of 70 to 80 lakh Self Help Groups (SHGs), essentially of poor women across the country.

We have categorised States into different levels depending on the capacities that exist and the social capital already available in each state. It will be implemented in a phased manner but eventually all States are expected to come on board by 2020-21. Today, 16 lakh Self Help Groups in 1229 blocks are within NRLM fold. I have personally interacted with some of these SHGs in Andhra Pradesh and Jharkhand. I am convinced that the philosophy and strategy of NRLM compliant SHGs holds a great promise for faster, more inclusive growth and removal of abject rural poverty in the next 10 to 12 years. It will not be an exaggeration if I say that a silent revolution for a better life is shaping up in rural areas through this programme.

These strong grassroots institutions of poor women indeed go beyond livelihoods. Investments in social and economic mobilization of the rural poor leads to increased voice, participation and representation of the rural poor in local governments and creates a demand side accountability and pressure for better access to various legal entitlements from Government right up to the last mile service delivery and consequent effective implementation of the programmes and good governance at the local level.

Going Forward

Sustained high economic growth coupled with equity or social development is a necessary condition for permanent elimination of rural poverty. India's rural income is expected to grow to USD 1.8 trillion by 2020 from the present level of USD 572 billion. It is eminently possible that the next phase of high economic growth GDP in the country will be sustainable only on the strength of continued growth in rural areas. The other areas of health, nutrition and education, which have a direct impact on poverty reduction, will need to be given greater focus and resources. For example, if the initiative approved with an outlay of Rs. 30,000 crore during the 12th Plan by the Government in 2011-12 on the recommendation of the sub-working group of the 12th Plan for free supply of essential medicines is implemented without delay and free medicines are made available to all those who access healthcare in any public health facility across the country, individual out of pocket (oop) expenditure on healthcare will come down sharply and will thereby help people come out of poverty or prevent people from falling into poverty.

The youth of the country is becoming increasingly more aspirational and assertive. Rural youth is no longer lagging behind in view of growing use of ICT and social media. Aspirations of the skilled youth cannot remain unmet or unattended for a long time. More skilled jobs are needed in the formal or manufacturing sector, particularly through small and medium enterprises. To facilitate this, reform in labour laws and processes of doing business has to be a top priority.

Skill development requires to be taken up by the Central Government, State Governments and the private sector in a holistic manner on a much larger scale. Huge skill gaps in professions ranging from masons, plumbers, electricians, security guards to nurses and teachers persist. India's educationally skilled workforce is limited to only about 10 per cent, trained formally (2 per cent) and informally (8 per cent). Training capacity remains grossly inadequate in as much as all technical training institutes taken together can only train about 3 million people per year, whereas over 12 million people enter the workforce every year. The capacity for quality training and re-training in trades including also those locally relevant would have to increase to 40 to 50 million per year over the next decade if we were to achieve the goal of training 500 million people by 2022. Perhaps, funds under the corporate social responsibility (csr) can concentrate on skill development alone for a specified period, say 3 to 4 years, in tandem with Government initiatives in this regard.

I personally believe that the living conditions of the rural poor receive very little attention. Problems of poor people in rural areas need to be given more space in public discourse. Discussions in drawing rooms as well as in Board rooms should pay more attention and be more sensitive to the issues of poor people in rural areas.

Inclusive growth and removal of rural poverty are the two sides of the same coin. Elimination of poverty is achievable. I look at the glass being half full and not half empty. The direction that we need to take, and the effort that we need to make, is how to make the glass full through concerted action in collaboration with all stakeholders including CSOs. We can ill afford to allow NRLM to become a precursor to any other similar government programme 4 to 5 years down the line. NRLM has to be inevitably the last and final weapon in our battle against rural poverty. The support structures will need to be professional and the staff quite sensitive to be fully mindful of this imperative. Actions that are taken today will determine the future. What we need is to bring the problems of poor people in rural areas and the goal of inclusive growth and poverty removal at the very core of the development and governance agenda of the country. ❑

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DO YOU KNOW?

BIG DATA

Big Data is a term employed to refer to a collection of data that is too large and complex to be processed by on-hand database management tools and systems. Big data poses challenges pertaining to capture, processing, storage, transfer and analysis among others. Interpreting and analysing this data continues to be a challenge and effective management of big data can lead to several new developments. The growth of data sets in size is partly due to the gathering of information simultaneously by technological devices like cameras, mobiles or wireless networks. It is difficult to use big data with conventionally used relational database management systems.

The magnitude of data available in today's world is extremely immense and conventional databases seem inadequate to manage them. According to an article in the Economist magazine, Wal-Mart, a retail giant, handles more than 1m customer transactions every hour, feeding databases estimated at more than 2.5 petabytes—the equivalent of 167 times the books in America's Library of Congress. Further, the amount of data available is growing at an unstoppable rate. The potential of big data can yield great economic benefit, if managed well.

One of the biggest challenges posed by big data is lack of available storage space. There is a massive difference in the proportion of information created per second and the proportion of space available to store it. Further, data security and data privacy are also grey areas where, often lack of regulation can lead to data loss or worse, data theft. Given the ever-increasing proliferation of data in our life, the area of management of big data is bound to grow as processing, analysing and interpreting this data can provide hitherto unknown insights to businesses. It is not just that new data is being created but also being shared increasingly on different platforms, adding to the size. This is also evident by the massive amount of traffic that the Internet is seeing today. While there is a widespread acknowledgment that data is growing by the years, there is also the difficulty of quantifying it. Currently, information is measured upto zettabytes (ZB) and yottabytes (YB). Researchers are yet to come up with terms to describe data beyond these sizes. There have been claims that applying sophisticated quantitative solutions can even help build economies around big data. One of the biggest repercussions of relying on big data has been the recent economic crisis where it is said that while banks were using models that worked on big data, yet those failed to reflect the financial crisis. If big data is not managed well, it can definitely cause more problems of this kind. Given that most of us are seeing 'big data' for the first time, it becomes extremely crucial to focus on building physical and technical infrastructure to manage big data effectively and extract maximum benefit from it.

GREEN BOND

According to Investopedia, green bond refers to a tax-exempt bond which is issued by federally qualified organizations for the development of brownfield sites. Brownfield sites are areas of land that are under-utilized, have abandoned buildings, or are under developed. They often contain low levels of industrial pollution. Green bonds actually stand for Qualified Green Building and Sustainable Design Project Bonds. The purpose of these bonds is to encourage green economies through the development of brownfield sites. The tax-exempt status makes a green bond a more attractive investment compared to otherwise taxable bonds. Also known as climate bonds, these bonds are considered an environment-friendly means of business. The purpose of such a move is to encourage businesses to pursue more climate-change solutions. These bonds may be used to either pursue green businesses or raise investments to create them. The London-based Climate Bond Standards Board provides a certification program for Climate Bonds. Given that government funding may never be adequate to deal with climate-related challenges, green bonds are an interesting and innovative way to make businesses spare a thought about those. In 2008, the World Bank launched the "Strategic Framework for Development and Climate Change" to help stimulate and coordinate public and private sector activity to combat climate change, with the World Bank Green Bonds being a crucial part of this framework. The World Bank has mobilised over $5.3 billion through 61 green bond transactions in 17 currencies and the IFC has issued $3.4 billion in green bonds in 2013. According to the World Bank, new Green Bond Principles being developed by leading investment and commercial banks are also expected to encourage more investors. Increased focus on climate change has led to an innovative solution like green bonds. Often green bonds can help earn investors tax benefits even though they generally carry the same credit ratings as the issuers' other debt obligations. The World Bank has been the first entity to issue green bonds, in 2008.

Green bonds were first employed in the US by the Commonwealth of Massachusetts, which in June 2013 sold $100 million of 20-year notes it referred to as "green bonds." While the market for green bonds is growing, it faces challenges in the form of issuance scale, liquidity and monitoring. However, much of it can be achieved easily if governments play an active role in creating a secure policy environment that encourages this practice. ❑

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