Reduce, Improve, Replace: To meet the energy challenge[1]

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1 Introduction

India’s energy policy in the future will have to navigate through largely uncharted territory. Never before has a country had to provide access to modern energy and build basic infrastructure for so many millions in so short a time, while also ensuring all-round development and growth in a situation constrained by limited natural resources, environmental degradation and increasing pressures brought on by climate change. There are no easy solutions to address such a complex and seemingly contradictory set of goals and India will have to find a development trajectory that fits its unique requirements. While there are some positive signs of recognising the need for innovative and different approaches, the overall picture is currently not very encouraging. The key challenge that India has to address in order to overcome these problems is to improve its governance processes and institutions to make them more capable, effective and accountable.

This paper starts by taking a look at the India’s energy supply and use, highlighting the energy poverty, and the correlation between energy and development. It then highlights the three-fold energy challenge related to resources, socio-environmental issues and climate. A framework to meet the challenge is presented by way of Reduce-Improve-Replace for electricity, which could be adapted to other sectors like transport, agriculture, construction, clothing or even health. The current trends – positive and negative – and challenges in adapting this framework are also presented.

2 Insights into India’s energy supply and use

It is important to have a quantitative feel of energy supply and end use, including the significant role of non-commercial sources of energy, especially in cooking. It is also important to study the correlation between energy and development and the extent of India’s energy poverty.

2.1 Energy supply and end use

Most presentations on India’s energy supply and use concentrate on commercial sources and their use. Figure 1 and Figure 2 give data on energy supply and use for both commercial and non-commercial sources.

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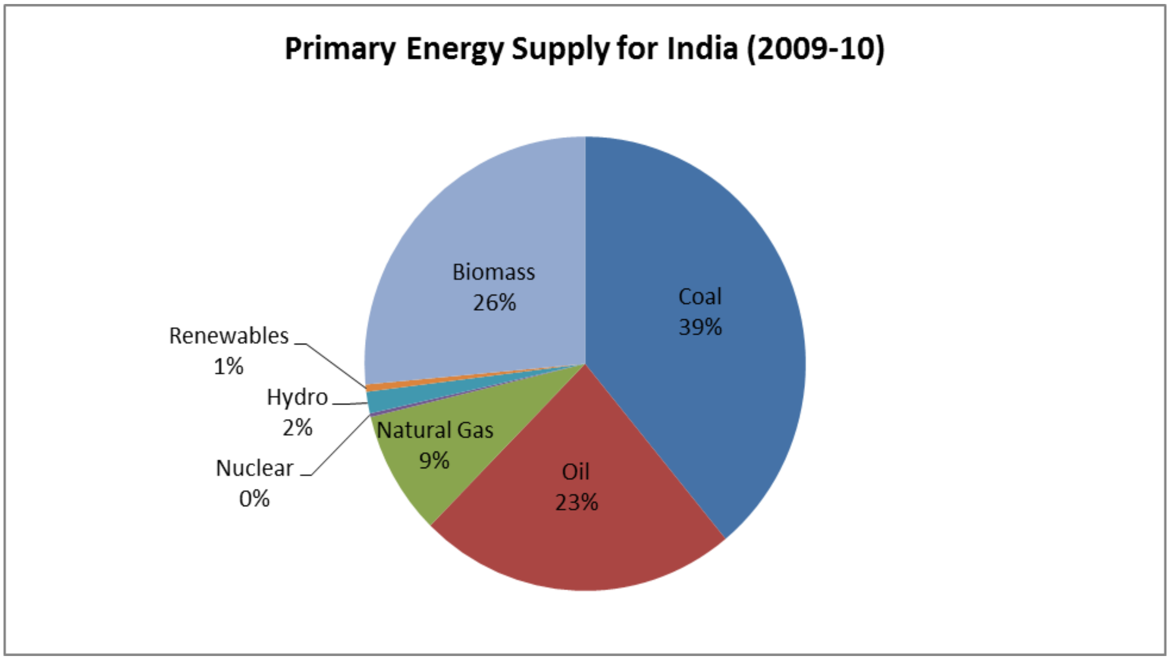

Figure 1: Primary Energy Supply of India (2009-10), Source: [TEDDY 2012]

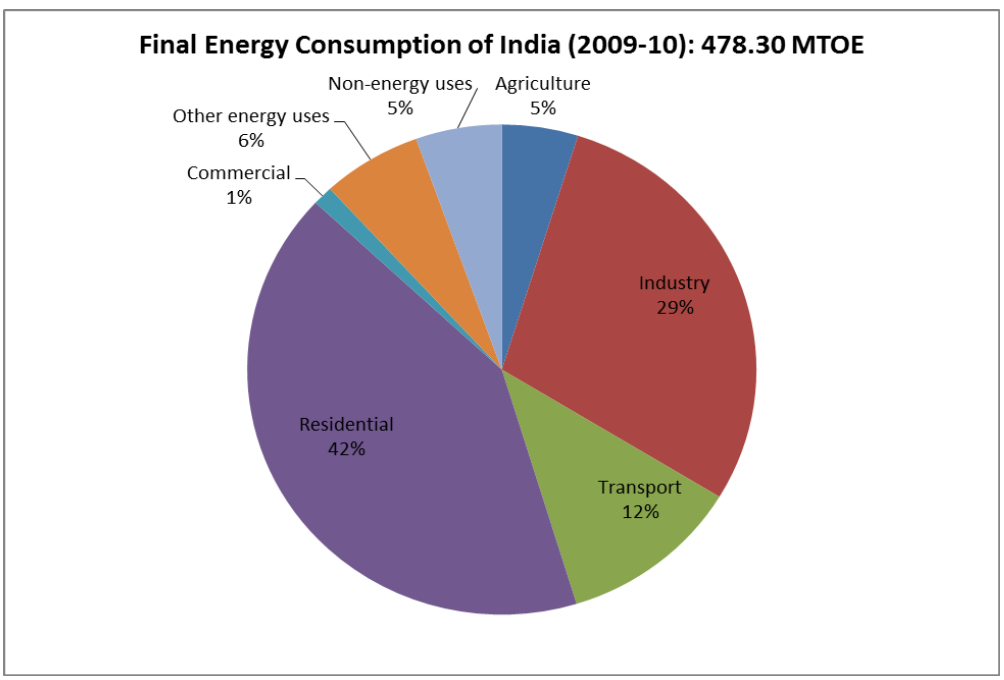

Figure 2: Final Energy Consumption of India (2009-10), Source: [TEDDY 2012]

From Figure 1, it can be seen that coal (39%) is the dominant source of energy, but what may surprise many is that bio-mass is the second biggest source (nearly 26%). From Figure 2, it can be seen that households are the highest consumers of energy. More than half of this is bio-mass, since two-third of the households depend on bio-mass for cooking. In all the debates on India's energy challenge, one should not lose sight of this aspect.

2.2 Energy poverty

It is now well understood that there is a close correlation – if not causality – between access to modern forms of energy and the level of development of a nation. As can be inferred from Figure 3, there is a strong correlation between a small increase in per-capita energy consumption and significant improvement in development indicators for nations at the level of development of India (as measured by Human Development Index - HDI in this example).

India's relatively low HDI levels are consistent with low levels of access to modern energy forms in India. Figure 4 depicts the energy access deficit in India as determined from the national census conducted in 2011 [Census 2011]. About a third of India (400 million citizens) does not have access to electricity and over 80% of Indian households, representing almost a billion citizens, use less than 100 kWh / month for their residential uses. An interesting contrast can be drawn between the average per-capita annual electricity consumption of an Indian and a citizen of the USA: while an average Indian consumes less than 600 kWh[2] annually, an average American consumes nearly 12,000 kWh annually. Similarly, 66% of the population (about 800 million people) rely on traditional bio-mass for cooking, rather than cleaner and modern sources of energy[3].

It should be also said that energy poverty is not just about lighting or cooking fuel, even though there is a lot to be done with regard to home lighting and efficient cook stoves. Meeting the community needs (drinking water, health centre, food storage etc.) and supporting economic activities (agriculture pumping, small business etc.) are also critical. This calls for sufficient supply of electricity at affordable price.

[2] This represents the total electricity consumption across all sectors divided by the population, and not just the residential electricity consumption

[3] A small percentage of the bio-mass based cook-stoves are 'clean stoves' that do not result in high levels of indoor air pollution. It is hard to find concrete numbers for the number of such stoves, but counting them as clean energy usage does not change the overall picture in any significant way.

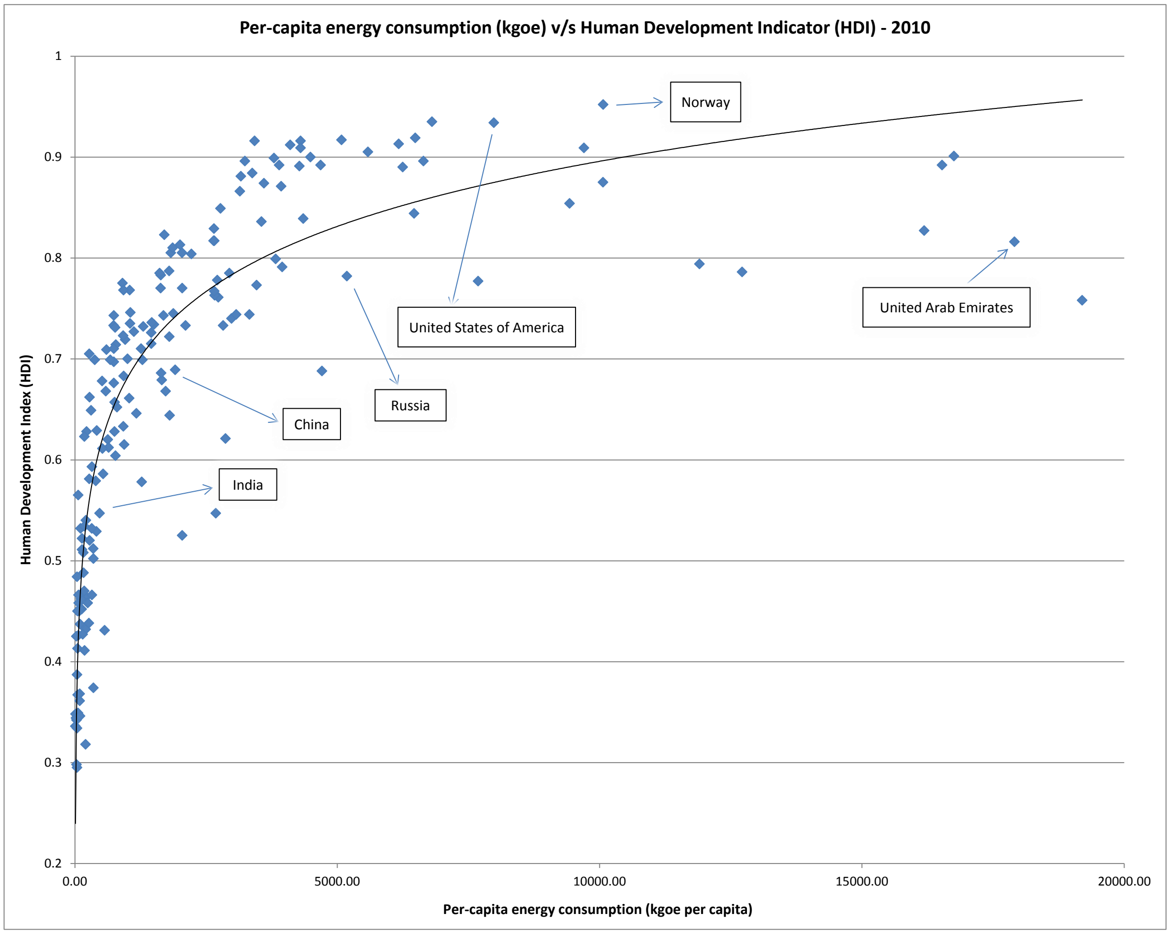

Figure 3: Correlation between energy consumption and HDI[4]

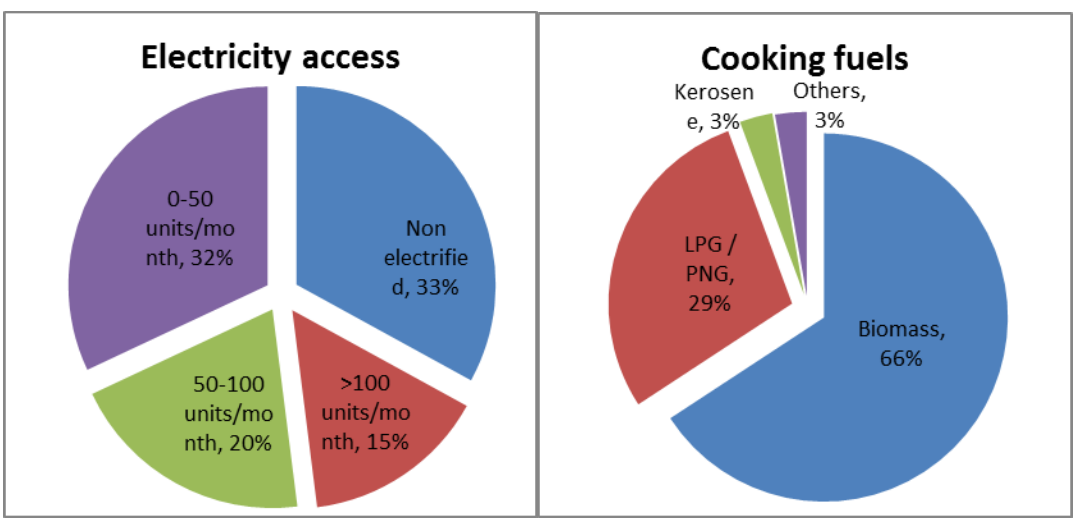

Figure 4: Energy access deficit in India[5]

[4] Source: [UNDP 2012, World Bank 2012]

In addition to low levels of access to modern energy sources, India also suffers from a huge deficit of infrastructure required for dignified living. Figure 5 provides indicative estimates of the infrastructure deficit by collating data from different Government sources. Almost half the houses in India do not have concrete or brick walls, more than half the households do not have toilets, nearly half the villages do not have access to basic health care facilities, about a quarter of the villages do not have all-weather roads and about a fifth of the villages do not have primary schools. Such an infrastructure deficit obviously needs to be bridged, in addition to providing access to modern energy, if India wants to ensure that its citizens lead dignified lives. Providing such infrastructure would also require significant amounts of energy.

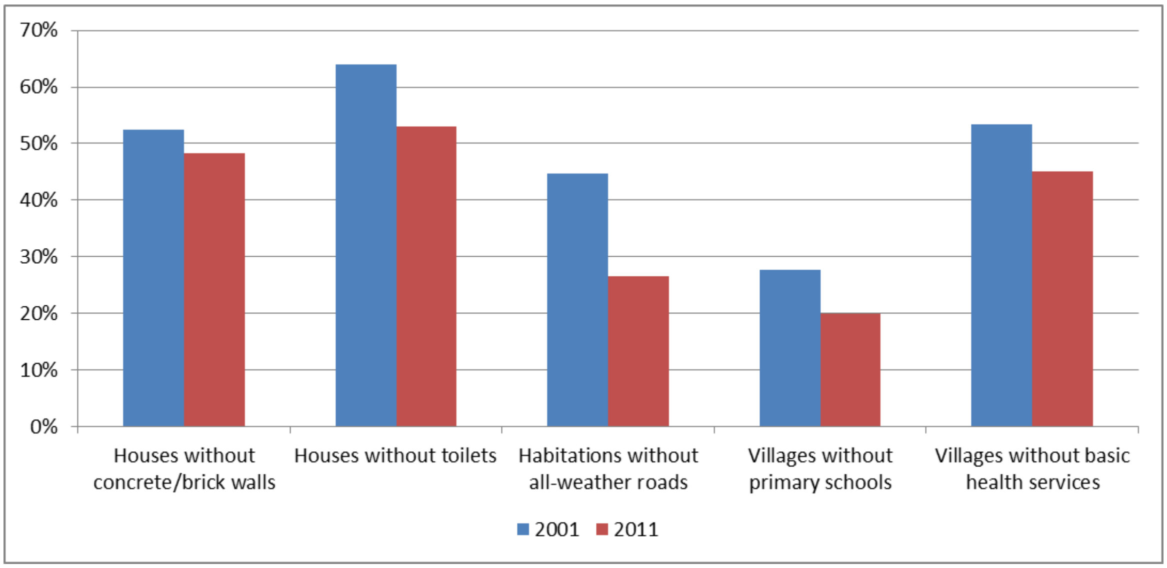

Figure 5: Infrastructure deficit in India[6]

The above discussion highlights the large unmet demand for energy in the country. Moreover, this demand is typically from a segment of the population that would be less able to pay high prices for access to such energy and infrastructure.

Official demand projections such as the Integrated Energy Policy (IEP) [Planning Commission 2006] also project large increases in energy demand, though these may not necessarily be based on such bottom-up assessments. For example, the high energy efficiency, maximum renewables and nuclear scenario (scenario 11) of the IEP implies an *incremental* electricity demand between 2026-27 and 2031-32 of about 800 billion kWh which is comparable to the total electricity generated in the country in 2010-11 [CEA 2013].

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[5] Source: [Census 2011] and Prayas calculations

[6] Source: [Census 2011, Census 2001, GoI 2013, NSSO 2002] and Prayas estimates. Data related to schools and health centres in villages is for 2002 and not 2001.

3 Energy Challenge

What would be the implications of such large increases in demand for a country like India? We present three implications of such an increase in demand, which would act as limiting factors to satisfying India's energy needs by pursuing a 'business-as-usual' path. These are related to resources, socio-environmental issues and climate.

3.1 Resource constraints

The first implication is the impact on India's energy security and larger economy. India's energy import costs as a percentage of its GDP is significantly higher than the share of energy import costs in the GDP of many other countries [Sreenivas 2012]. As shown in Figure 6, though India imported only 24% of its commercial energy requirements in 2008, it spent 7% of its GDP on energy imports. In contrast, Japan imported 82% of its energy requirements but spent only about 4.5% of its GDP on such imports.

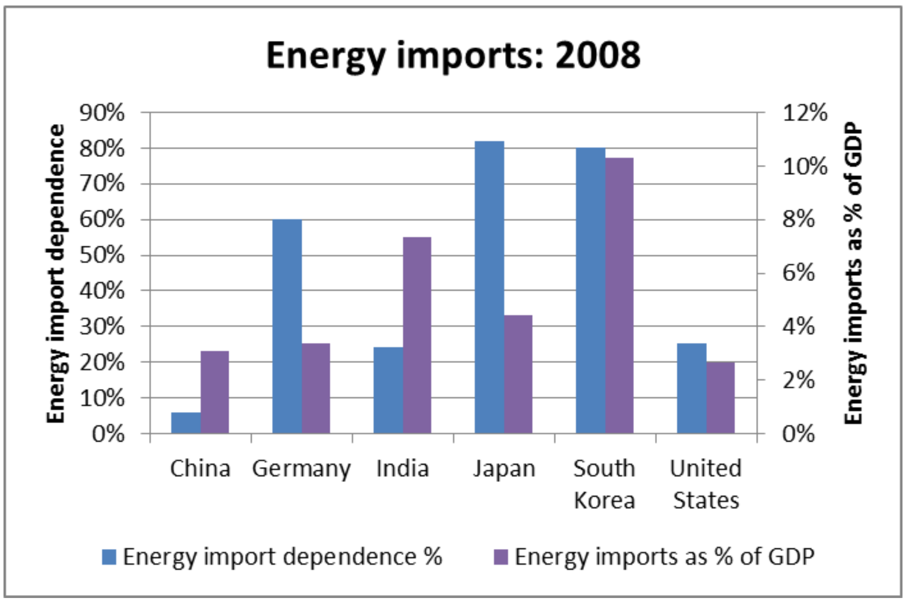

Figure 6: Energy import dependence and energy imports as share of GDP[7]

Given increased energy demand projections, the country's energy imports are only expected to increase, as India is not a resource rich country. India is not endowed with large resources of oil and gas, and imports about 80% of its oil requirements. Though India is believed to have reasonably high reserves of coal, these are of poor quality and there are doubts about accessing the reserves effectively. Projections of energy production and demand given in the country's 12th five-year plan [Planning Commission 2012] indicate increasing energy imports during the 12th and 13th five year plans. Assuming a modest 5% annual increase in unit cost of imports,

[7] Source: [World Bank 2012, EIA 2012]

India's energy import bill rises significantly and takes up a higher share of the country's GDP by 2021-22, even if the GDP is expected to increase by about 8% p.a. (Figure 7).

Such an increase in the import bill exposes the country to many energy security and economic risks. Firstly, increasing/higher share of imports in our energy supply will almost surely lead to an increase in energy prices. In turn, this will make it harder to universalize access to clean energy and costlier to build the required infrastructure, particularly since the segment of population whose needs have to be met have a low capacity to pay for it. Secondly, increased exposure to energy imports would imply a greater vulnerability of the country to global geo-political risks. This could manifest in the form of either price fluctuations or supply vulnerabilities or both. Thirdly, it would have consequences for the country's macro-economic stability as it would increase the country's trade deficit significantly. Energy imports already contribute over 60% of the country's trade deficit (2011-12) according to data from the Ministry of Commerce, and an increase in import quantities and prices would only worsen the situation.

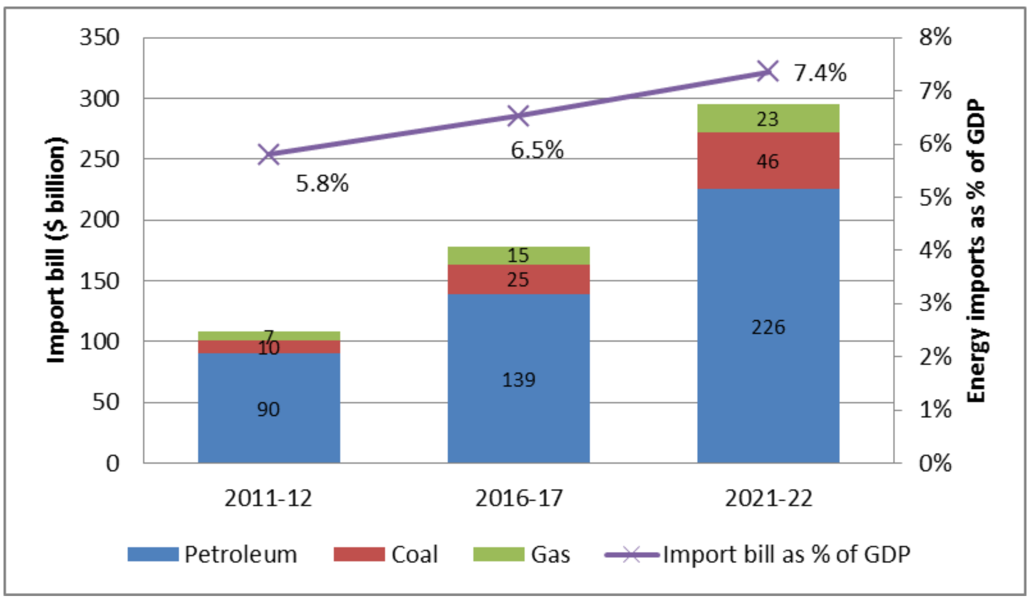

Figure 7: Projected Indian energy imports[8]

[8] Source: [Planning Commission 2012, MoPNG 2012, MoC 2012, MoC 2011]

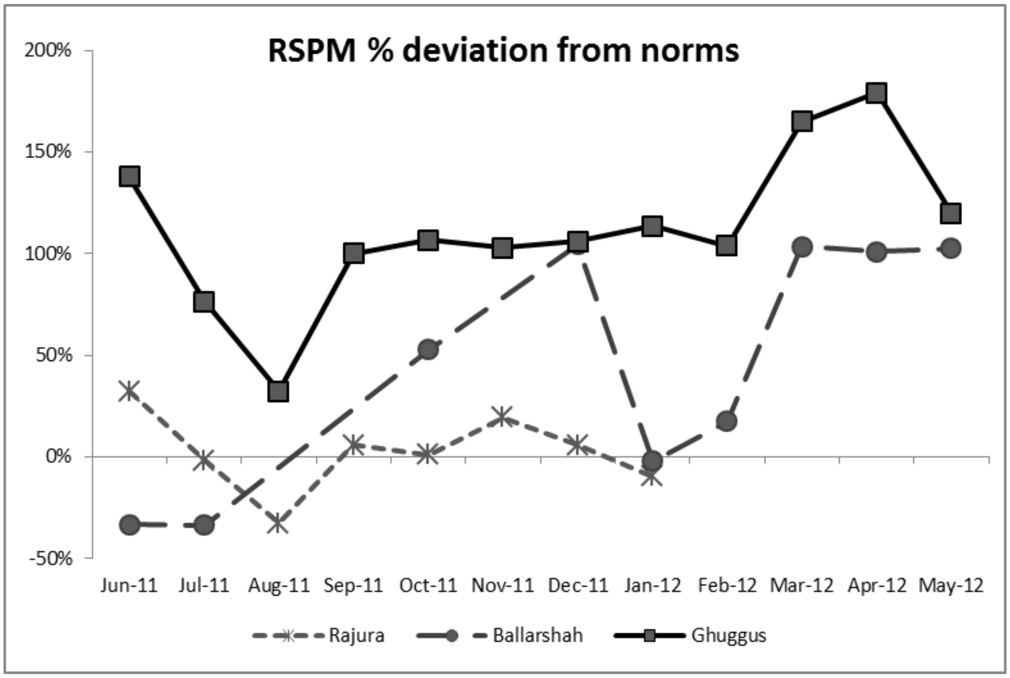

Figure 8: Air pollution in areas with coal mining and associated industries[9]

3.2 Socio-environmental constraints

The second implication relates to the significant negative socio-environmental impacts of exploiting domestic energy sources such as coal, and energy transformation processes such as power generation. Evidence gathered from regions with extensive mining and power production indicates air and water quality that is considerably worse than the norms [MPCB, TERI 2000, Thakre 2011] – this is also indicated in Figure 8. Weak monitoring capacity and mechanisms of the concerned agencies such as the pollution control boards and the Ministry of Environment and Forests have not helped to mitigate this. Poor air and water quality are exacerbated by the social dimension of such activities which involves displacement and loss of livelihoods [Prayas 2012]. Increased exploitation of domestic sources and/or significantly greater number of power plants will only worsen these impacts, unless suitable corrective mechanisms are instituted to address these problems and implemented in the right spirit.

3.3 Climate constraints

The third implication is the impact of such an increase on climate change. Measured by any metric, India does not emerge as a country responsible for climate change and therefore, any obligations to accept limits on its GHG emissions [Dubash 2012]. However, it is also true that India as a country, and its poor in particular are highly vulnerable to the impacts of climate change. For this and other reasons, India needs to play a constructive role [Dubash 2012a,

[9] Source: [MPCB 2012]

Raghunandan 2012] in battling this global challenge and undertake some actions to 'bend the curve' of its GHG emissions without sacrificing its development imperatives. The projected rapid increase in energy consumption will require to be managed very carefully in this context.

Any simplistic approach to satisfying the country's energy demands is unlikely to work. A business-as-usual fossil-fuel heavy approach will have macro-economic and socio-environmental risks. On the other hand, an aggressive push for renewables 'at any cost' will badly affect the development agenda of providing universal energy access and basic infrastructure, since it is expected that the cost of renewable energy is likely to be higher than fossil-fuel energy for the short to medium term.

Over the next few decades, India's energy policy will have to navigate through uncharted waters. Never before has a nation had to rapidly meet the developmental aspirations of so many millions under such constraints of natural resources, economy and the environment. It will not be easy to find appropriate solutions amidst these constraints, and doing so will require innovative and carefully calibrated policy formulation and institutional design.

4 Framework for India's energy future

In this section, we explore a broad framework for India's energy future that can help in achieving the desired goals of achieving development objectives at a minimal cost to the environment, without endangering the country's energy security. Conventional economic wisdom suggests the following cause and effect relationships.

- Human development requires GDP growth
- GDP growth requires increasing consumption of energy
- Increasing consumption (and production) of energy will have some negative socio-environmental impacts

However, none of the above relationships are rigid, and so attempts should be made to weaken these links. This will simultaneously improve developmental indicators while consuming less energy and reducing environmental impacts. For example, suitable development policies can ensure that equivalent GDP growth can result in better development for its citizens (say, in the form of reduced malnutrition or infant mortality or maternal mortality etc.). Improving the efficiency of the economy can help in reducing the amount of energy required to achieve a unit increase in GDP. Finally, negative socio-environmental impacts of increased energy production and consumption can be reduced through a combination of better technology and better formulated and implemented policies.

Focusing on the energy sector, we present two broad frameworks in tune with the principles laid out above – namely, improved developmental policies at greater economic efficiency and causing minimal impact on society and environment.

4.1 RIR framework for the electricity sector

In the electricity sector, a framework called the 'Reduce-Improve-Replace' (RIR) framework has recently been proposed [Sant 2012] as a way forward. The essence of this framework is to:

- Reduce consumption towards making energy distribution more equitable
- Improve end-use efficiency
- Replace fossil fuels with renewable sources

This is elaborated below.

4.1.1 Reduce consumption and inequity

The first dimension of 'Reduce' is to reduce the high-end 'luxury' energy consumption through a suitable combination of incentives and disincentives. For example, telescopic electricity tariffs that are steep for high consumption would protect those using lesser amount of electricity and send a signal to the high-end consumers to reduce their electricity consumption. Air conditioners are the main contributor to urban electricity consumption. Since ACs are typically used by the more affluent class, high tariffs for this high consumption could distribute power equitably. Moreover, since AC load follows the sun, there is a strong case to promote the idea of 'solar for ACs'.

The second dimension is about reducing inequity in distribution of energy resources. After six decades of independence, which saw significant growth in the economy and energy infrastructure, India faces among the highest levels of energy poverty anywhere in the world. Even today, nearly two-third of the population relies on traditional biomass for cooking and heating. The situation in electricity is no different. India has the dubious distinction of being home to the largest number of people without electricity anywhere in the world. One-third of Indian households (400 million people) do not have access to electricity, which constitute a third of the world's population without electricity. Though electricity generation has increased by 75% in the last decade (2002-12), it has only led to about a 12% increase in access for households. The trends are similar for previous decades as well. It is important to have programs with the explicit focus of ensuring connections and affordable quality electricity supply to the poor. Experience from successful international rural electrification efforts indicates the need for a comprehensive approach with a one-time push by all concerned agencies. This should cover all dimensions of rural electrification: setting up infrastructure, providing universal access, supplying affordable and adequate power, and promoting productive load [Prayas 2013a].

4.1.2 Improve end-use efficiency

This involves improving the efficiency of electricity use through a combination of incentives for efficiency improvement, penalties for inefficient consumption and introducing standards for energy usage. This is a well-known method to enhance energy security. End-use efficiency is cheaper than any form of electricity generation, but there are many challenges in implementing it. Efforts in end-use efficiency must be directed at the areas where we will get the biggest reductions in energy use ("maximum bang for the buck"). Our policies and plans must be designed for a radically higher level of implementation our schemes should be designed creatively to address the challenges of the Indian environment.

For India, end-use efficiency holds opportunities. About 70% of the infrastructure in 2030, such as buildings, will be added in next two decades – between 2010 and 2030. If these are built inefficiently, we will be locking-in this inefficiency. For appliances and equipment though, the issues are similar: with faster growth and shorter life than infrastructure, the time span for action and impact is shorter. With energy expected to be scarce and costly in 2030, such inefficiency would be a major handicap for the country. The achievable end-use efficiency potential in the coming decade is larger than the likely combined capacity addition through hydro, nuclear and gas-based power plants. Seen against this backdrop, it is alarming that due to insufficient policy response, we may miss out on such a large and low-cost opportunity to meet our energy needs and may get trapped with energy- inefficient infrastructure. End-use efficiency deserves the same importance as addition of electricity generation capacity [Prayas 2011].

There are on-going initiatives in the industry and large commercial sectors, but innovations are essential in the domestic, small commercial and agriculture sectors. Multi-state market transformation program for appliances taken up by BEE, where incentive is provided to the manufacturers, is an innovative program. This is proposed to be implemented for fans in the 12^{th} five-year plan. In case of agriculture, the challenge is tougher. Due to low tariffs, farmers have no incentive for using efficient pumps, while low revenues from this segment mean that distribution companies have no incentive to maintain good quality of supply. This has led to an ever deepening inefficiency trap involving wide spread use of inefficient equipment. This in turns results in a growing crisis in all related areas: electricity supply, groundwater table, food production and electricity distribution company finances. This is an area where no actor is happy and each actor finds fault with the other for the problems. Significant efforts are needed to break this inefficiency trap and develop an integrated approach that would address electricity, water, land, credit, and agriculture production.

4.1.3 Replace fossil fuels

This involves replacing fossil fuels with renewable sources of electricity. While this is also a well-known approach in the context of energy security and climate-change, it must be kept in mind that given the higher costs of renewable energy today in comparison to more conventional sources, policies to encourage renewables should be carefully calibrated to ensure that the poor are shielded from the impacts of shifting to the costlier energy source.

With many Central and State government initiatives, there has been significant progress in big grid-connected renewable systems. But there is a lot to be done in small off-grid or grid interactive systems, which contribute significantly to reduce energy poverty. A number of commissioned small renewable projects have failed to survive in the long-run due to unresolved technical, socio-economic and institutional problems. Sustainable development of the small renewable sector is hampered particularly by the high and inequitable tariffs for poor consumers, a lack of performance-based incentives and the perceived threat from the expanding centralised grid at the project location. Grid coverage has been steadily increasing with 94% of the villages electrified [CEA 2013a]. Stand-alone systems are important in remote areas where the grid cannot reach. In other areas where the grid has reached or is likely to reach in the near future, planning to connect stand-alone systems to the grid helps to supplement grid power, and increases the capacity utilisation of the stand-alone system. Therefore, they could be considered as a precursor to the grid where the grid has not reached and a supplement to grid power in grid-interactive form. Meanwhile, promoting grid-interactive renewable systems for urban consumers helps to stabilise the technology and solve implementation issues [Prayas 2013a, Prayas 2012a].

4.2 Other sectors

RIR approach in electricity is not completely new, as similar approaches have been proposed earlier for other sectors. This includes the Avoid- Shift-Improve (ASI) approach for the transport sector, Low-input Sustainable Agriculture/ Housing/ Clothing and Preventive & Social Medicine for the health sector. The ASI approach for transport is briefly described below.

In the transport sector, the ASI framework is well known [Dalkmann 2007, ADB 2009]. According to this framework, the principles underlying a shift towards sustainable transport solutions, which minimize socio-environmental impacts and enhance energy security, are as follows:

- Avoid travel, i.e. minimize travel demand, to the extent possible, through better planning and design. Thus, a city would have neighbourhoods that are mixed-use, i.e. they would have residential locations, commercial outlets and opportunities for employment, education and entertainment all in close proximity, so that one's needs are met with minimal travel. Similarly, locating industries appropriately so that the supply chain and major consuming centres are reasonably close would ensure that the demand for freight movement is minimized.
- Shift to more efficient modes of travel, as a means of improving overall systemic efficiency. For example, shifting freight from roads to rail will greatly improve the energy efficiency of freight transport, while shifting passenger transport within a city or town from private motorized transport to modes such as public or non-motorized transport will significantly improve the efficiency of passenger transport.
- Improve the efficiency of individual vehicles by improving the technology and/or fuels used in them. This can further help to improve the energy efficiency of the transport system by improving the fuel efficiency of buses, cars or trains. This element of the framework could also encourage vehicles to shift to alternative fuels and technologies such as electric vehicles or hydrogen cell powered vehicles.

Broadly, the paradigms listed above (RIR for electricity and ASI for transport) target the multiple objectives listed earlier: providing access to all, minimizing resource use and hence the associated socio-environmental impacts, and discouraging excessive consumption. Specific elements of these frameworks that are suitable for the Indian context will need to be identified and converted into suitable policies. Similar frameworks and approaches can be developed for other sectors such as agriculture, health and so on.

It should be noted that while a framework as listed above would gradually try to increase the share of cleaner energy sources such as renewables in the energy mix, energy systems are 'sticky' and have long gestation periods as well as lifetimes. As a result, even if India embarks on a path aggressively embracing renewables and efficiency, it is likely that India would continue to depend on fossil fuels as its primary source of energy for about a decade or two. This is also indicated by the IEP [Planning Commission 2006] which predicts that even in the scenario with the least amount of fossil fuels, India will source over 70%, in comparison to over 90% currently, of its primary commercial energy from fossil fuels in 2031-32.

5 Current trends and challenges

A look at the current trends shows some positive and negative trends, which are discussed below. There are also serious challenges in governance.

5.1 The positive signs

In the electricity sector, India has initiated a few actions over the last few years that are consistent with the RIR approach.

Under the National Action Plan on Climate Change (NAPCC) [GoI 2008], India has launched eight missions, one of which is the National Mission on Enhanced Energy Efficiency (NMEEE) [GoI 2009], under which various schemes have been initiated to improve the energy efficiency of India's economy. The Bureau of Energy Efficiency (BEE), set up under the Energy Conservation Act of 2001 [GoI 2001], is charged with the mission of improving India's energy efficiency and has been the nodal agency that has driven the energy efficiency agenda. BEE has introduced schemes for standards and labelling of electrical appliances and improving the efficiency of energy-intensive industries through Perform, Achieve and Trade (PAT) scheme under the NMEEE to save up to 23 MTOE of fuel annually by 2014-15 and avoid cumulative addition of 19 GW capacity of electricity [MoP 2012]. It has also developed codes for energy efficient buildings. Setting up of Energy Efficiency Services Limited (EESL), a joint venture of PSUs of Ministry of Power in 2010 is another positive step.

Another mission under the NAPCC is the Jawaharlal Nehru National Solar Mission [27] that proposes to give a significant boost to the solar power sector and targets a solar-based grid connected power generation capacity of 20 GW by 2022. Similarly, the recently released 12th five-year plan document [Planning Commission 2012] proposes the establishment of a National Wind Energy Mission, similar to the solar mission, to boost the wind energy sector. India has also introduced mechanisms such as tradable Renewable Energy Certificates (RECs) and imposed Renewable Purchase Obligations (RPOs) on power utilities to promote adoption of renewable energy.

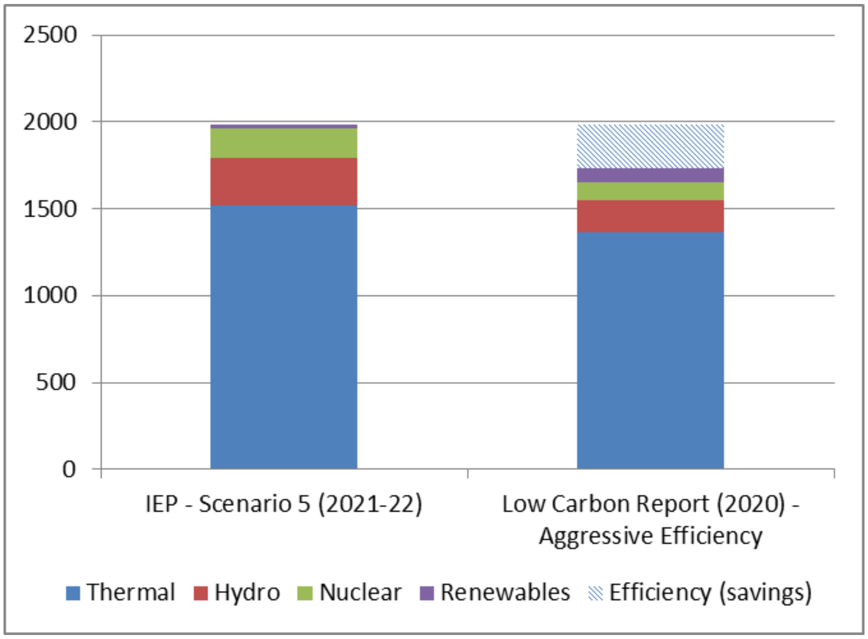

Figure 9: Two projections of electricity demand (Billion kWh)[10]

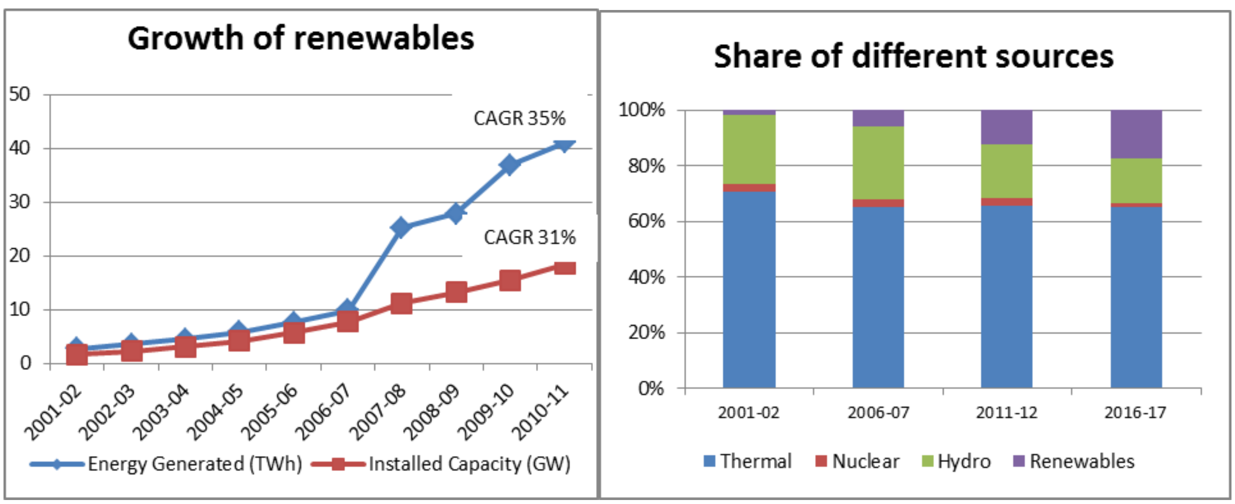

Figure 10: Changing role of renewables[11]

These initiatives are reflected in official demand projections and actual achievements. As shown in Figure 9, two official electricity demand projections for comparable years from the Planning Commission – scenario 5 from the IEP for 2021-22 and the 2020 demand projected under the aggressive scenario of the interim report of the Expert Group on Low Carbon Strategies for Inclusive Growth [Planning Commission 2011] – show a dramatic difference. There is a significantly enhanced role for energy efficiency, or avoided demand, in the projections of the

[10] Source: [Planning Commission 2006, Planning Commission 2011]
[11] Source: [CEA 2013, Planning Commission 2012, MoSP 2012]

latter amounting to about 13% reduction in demand. In fact, the projected reduction in demand due to energy efficiency is greater than the incremental demand met from nuclear, gas, hydro and renewable sources put together during 2011 to 2020, highlighting its importance.

Similarly, the share of renewables has also been increasing significantly in the power basket. Figure 10 shows that renewable energy capacity has been growing at 31% per year over the last decade, with renewable based electricity generation growing at 35% per year – or doubling every two years. This is reflected in the fact that investments in the renewable energy sector were to the tune of about Rs. 20,000 crores (approximately USD 4 billion) in 2011-12. Not surprisingly, the share of renewables in the Indian power capacity basket has steadily increased and stood at 12% at the end of 2011-12 and it is expected to further increase to 17% by 2016-17 (Figure 10). India has also targeted that 15% of its electricity will be produced from modern renewable sources by 2020 [GoI 2008], which represents an ambitious 6-fold increase in production from about 51 billion kWh in 2011-12 to about 235 billion kWh in 2020. These examples show that India is faring reasonably well on the 'Improve' and 'Replace' part of the RIR framework for electricity.

5.2 The not-so-positive signs

However, the country is not faring so well when it comes to the 'Reduce' in the RIR framework for electricity and most aspects of the ASI framework for transport. Over the last five years, three indicators of high-end consumption, namely sales of air-conditioners and cars, and total amount of air travel, have all been increasing rapidly at over 15% per annum (Figure 11). In contrast, it is interesting to note that the number of households using electricity as their source of lighting and the number of households with toilets have increased at a much slower pace of less than 5% per annum over the last decade [Census 2011]. This suggests that the 'Reduce' in the RIR framework has not yet been internalized or institutionalized in policy formulation and there is insufficient attention to curbing high-end consumption vis-à-vis addressing the access and infrastructure deficit.

The indications from the transport sector are also not encouraging. India imports about 80% of its oil requirements, and the transport sector is primarily fuelled by these imports. Therefore, in the interests of energy security, there should ideally have been a strong push towards implementing the ASI framework and improving the overall efficiency of the sector. However, as shown in Figure 11, car sales are growing rapidly. In addition, the share of rail in freight is decreasing steadily as are the modal shares of public and non-motorized transport across cities [Sunder 2008, MoUD 2008]. Weak railway infrastructure and poor railway services have partially contributed to booming aviation demand. Though there has been a lot of public discourse on introducing fuel efficiency norms for automobiles over the last few years [Sethi

2013, Jebaraj 2013], India has not yet been able to enact and implement such norms. Consequently the combined consumption of the transport fuels, namely gasoline, diesel and ATF, has increased at a rate of nearly 9% per annum over the last 5 years [MoPNG 2012] and the passenger-km logged by air has been increasing at 17% per annum as shown in Figure 11. It is evident that the ASI framework has not been internalized in the transport sector.

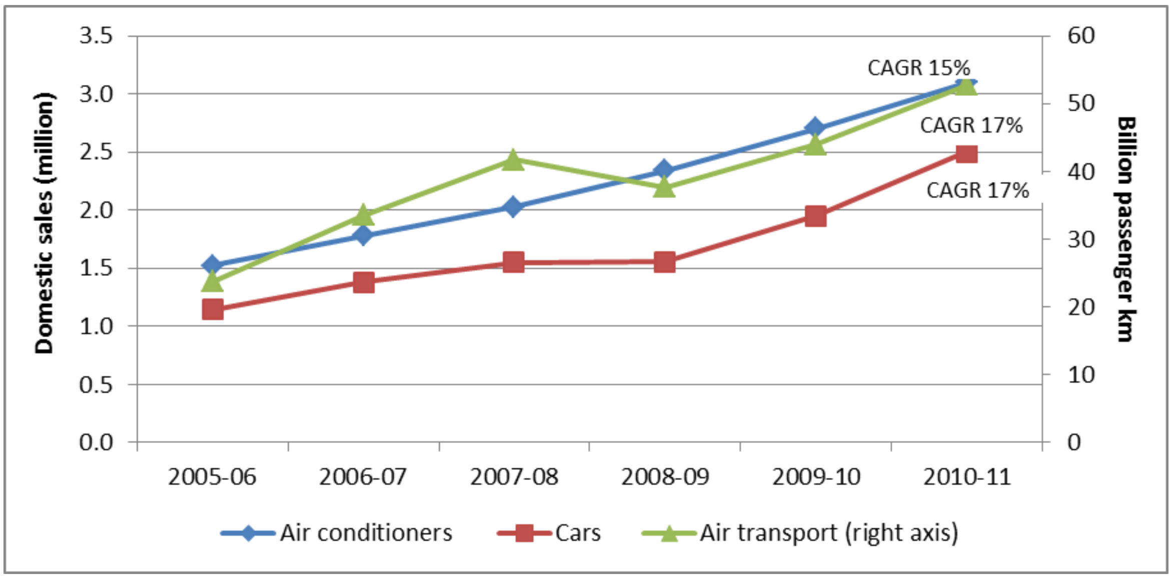

Figure 11: Growth of high-end consumption[12]

These issues of increasing high-end consumption co-existing with slower increase in access, limited natural resources, and insufficient attention to some key sectors, are serious concerns that need to be urgently addressed by the country's energy policy.

5.3 The governance challenge

As discussed earlier, India's energy policy needs to navigate through uncharted waters. This requires innovative policy formulation, efficient implementation and effective regulatory oversight, which in turn requires capable, committed and accountable institutions.

Unfortunately, India's record on governance and accountability of institutional mechanisms is weak. There are inconsistencies in data available from different sources as indicated in [Sreenivas 2012, Planning Commission 2011]. Capacity of governing institutions is a serious concern. To cite a few examples: an important agency such as the Bureau of Energy Efficiency did not have a full-time head for nearly one year, Central Electricity Authority has been short of

[12] Source: [Chunekar 2011, SIAM 2013, DGCA 2013]

staff for years and now reportedly operates with 50% staff strength [Livemint 2013], the Petroleum and Natural Gas Regulatory Board has just three members instead of the full bench of five, the idea of coal regulator has been hanging on fire for years, and issues still persist with vacancies and appointment in Electricity Regulatory Commissions[13]. There are problems of coordination across agencies as exemplified by various issues, such as the mismatch between coal linkages given and coal production capacity, inability to develop rail corridors for coal evacuation, and data mismatches across ministries. Finally, and perhaps most seriously, accountability mechanisms for various agencies are very weak – as illustrated by examples from the coal sector [CAG 2012, Prayas 2013], oil and gas sector [CAG 2012] and power sector [Planning Commission 2011a].

The institutional and procedural weaknesses of governance in the energy sector represent the most important challenge to be overcome, if India has to successfully provide energy services to its millions at the least financial and socio-environmental costs.

6 Conclusions

India's energy policy future would be constrained by the triple challenge of providing clean energy access to all its citizens, possessing limited natural resources of its own, and rising local and global environmental concerns. It is unlikely that any country has had to face such a challenge in the past. Therefore, it follows that India needs to chart out a unique path to meet its development challenges while addressing the other constraints.

Some broad frameworks have been presented for two sectors to guide the policy formulation process to address these challenges. Though there are some positive signs of following such a direction, the overall picture is not very positive. In our opinion, the most fundamental challenge that India has to overcome is to develop accountable and capable institutions that can then develop the innovative solutions that are warranted by the situation. A good beginning could be through setting up a dedicated multi-sectoral institution, such as an Energy Analysis Office, under the Planning Commission or the Prime Minister's Office to take a holistic view of the energy sector. Another step would be to significantly increase the transparency and public participation of governance institutions across the energy sector. While it may not be easy to develop such institutions and mechanisms, the country does not really have a choice in this regard, as not doing so will seriously imperil the country's energy future.

[13] A web based survey by Prayas indicated: Vacancies present for more than 1 year in SERCs was as high as 30% in the case of Chairpersons and 20% for Members. All SERCs had shortage of staff, the highest being 50% and the lowest 10%. As for background of chairpersons, members and secretaries (the key personnel in an SERC), it was dominated by administrative services (50%), retired or deputed personnel from regulated utilities (25%) and public sector (15%).

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