Sustainable Power: Unpacking the Buzz Word

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Abbreviations

CSO	Central Statistics Office
EIA	U.S. Energy Information Administration
IEA	International Energy Agency
CEA	Central Electricity Authority
MNRE	Ministry of New and Renewable Energy
IBEF	India Brand Equity Foundation
CSE	Centre for Science and Environment
Btu	British thermal units
GDP	Gross Domestic Product
kWH	Kilowatt Hour
BCM	Billion Cubic Meters
MT	Million Tonnes
Mtoe	Million Tonnes of Oil Equivalent
UNEP	United Nations Environment Programme
IAEA	International Atomic Energy Agency

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1 *SUSTAINABLE POWER: UNPACKING THE BUZZ WORD*

1.1 *INTRODUCTION*

Growth demands energy. With a real GDP growth rate of 8.7 % over the last five years, India stands as the ninth largest economy in the world (CSO, 2013) and in terms of purchasing power parity, India was the third-largest economy in 2013 (EIA, 2014). India was the fourth largest energy consumer in the world after China, the United States, and Russia (ibid) and the increasing demand for energy in the country, along with that of China has triggered a process of shift of the centre of energy demand from OECD countries to Asia.

Primary energy consumption has more than doubled between 1990 and 2012 reaching an estimated 32 quadrillion British thermal units (Btu) (ibid) and the per capita energy consumption has increased from 441 kilowatt hour (kWH) to 673 kWH (IEA, 2013) during the same period. While the installed capacity of power has seen an increase over the years, the energy demands have far outstripped this capacity leading to large scale energy deficits.

With a projected GDP growth rate at 9% per annum it is estimated that in order to sustain this growth, India's primary energy supply will need to increase by 4 to 5 times and its electricity generation capacity by 6 to 7 times over its 2003-04 levels (Integrated Energy Policy, 2006). This in turn has raised the need to promote energy security, which as defined by the Integrated Energy Policy of India (2006), encompasses three critical dimensions: (a) meeting India's large energy demand to sustain an annual economic growth rate of 8 to 9 percent 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.

Ensuring sustainability in energy or power supply (and use) is therefore of prime importance as it directly impacts the other dimensions included under the preview of energy security and in this regard, national and international efforts have been focused on what is called as 'sustainable power'. While this is undeniably an agreeable idea and used almost generously in literature on energy security in India and elsewhere, (the idea of) sustainable power will need some demystification and more importantly some contextualization. In this sense therefore, the subsequent sections of this paper will aim to unpack what sustainable power means in the Indian context and the challenges and opportunities that lie therein.

1.2 *OVERVIEW OF THE POWER SECTOR IN INDIA*

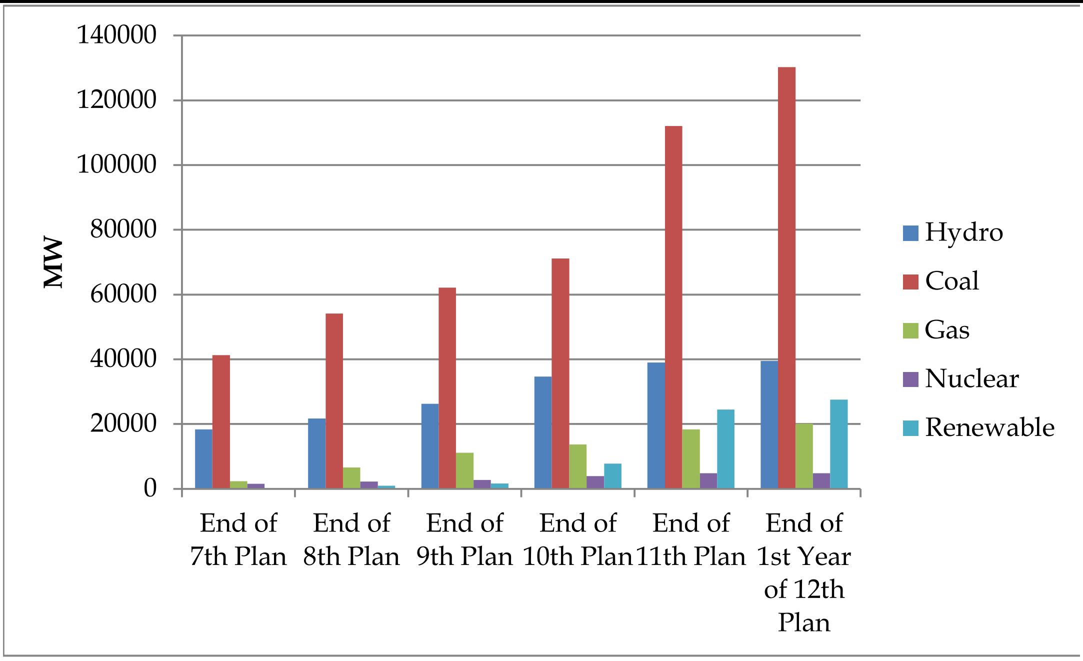
The power sector in India has seen a staggering growth from its nascent stages during the post-Independence period. The total installed capacity has increased nearly seventy-seven times its original value reported at the end of the 1st Five Year Plan (CEA, 2013). At the end of 2013, the total installed capacity of power in India was set at 228721.73 MW (ibid). Of the total installed capacity the State sector contributed 39.37%, Private 31.88% and Central (lowest), estimated at 28.73% (Ministry of Power, 2014).

1.2.1 *Major Sources of Power Generation*

Conventional Sources

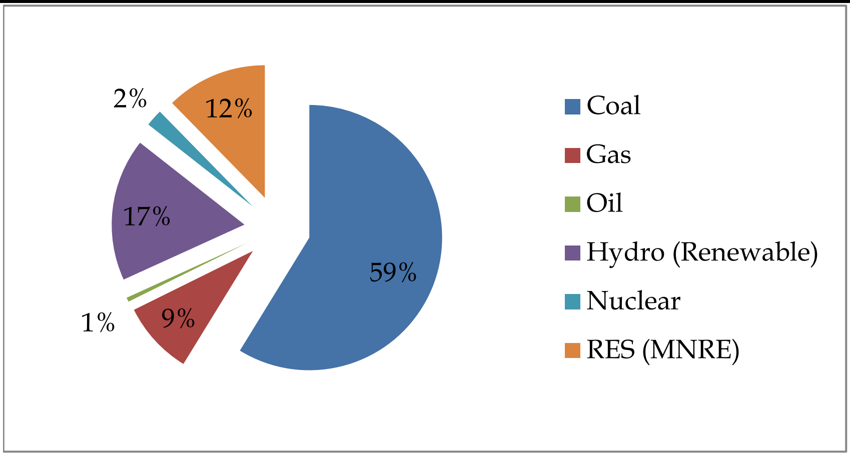
Conventional energy sources, specifically coal underpin the growth in the installed power generation capacity in India which can be observed through the overall trend in the growth of the mode-wise (or fuel wise) installed generating capacity in India (See Figure 1.1) (CEA,2013).

Figure 1.1 Plan-wise Growth of Installed Power Generating Capacity of India: Mode-Wise



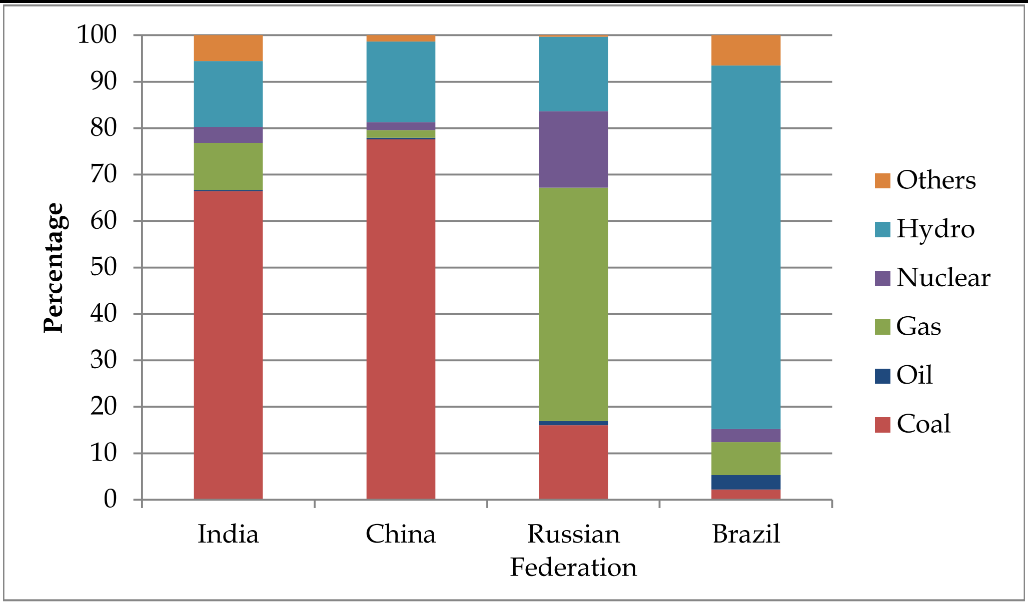
The distribution of power generation by fuel type as reported in 2013 is illustrated in Figure 1.2 (Ministry of Power 2014).

Figure 1.2 *Power Generation by Fuel Source*



The two figures highlight the dominance of coal in power generation which can be explained in part by the ease of availability and also by its relatively low cost. Coal reserves in India were estimated at around 293.5 billion tones as on March 2012 (CSO, 2013) and coal accounted for over 50% of the primary commercial energy supply in the country (CEA, 2013). Figure 1.3 highlights the importance of coal in power generation in India vis-à-vis the other BRIC countries.

Figure 1.3 *Utility-wise power generation by 2010*



In the above context, it is unlikely that coal will lose its pre-eminence as India's primary energy source over the coming decades however, if energy needs are to be met, the existing production scenario will need a significant improvement. This is due to the fact that in spite of the coal availability, the production and supply of coal has shown an increasing gap from 90 million tonnes (MT) at the end of the 11th Five Year Plan to an estimated 185 MT by the end of the 12th Five Year Plan (CSO, 2013) (which may undergo revisions and result in a higher gap than predicted).

The coal supply deficit has triggered increase in coal imports and as per the International Energy Agency estimates India is the third largest importer of coal following People's Republic of China and Japan (IEA, 2013). The huge price difference between domestic and imported coal, dynamism in the regulations of the countries from which coal is being imported at present, issues linked to land acquisition and regulatory clearances in India coupled with a lack of transport and power evacuation infrastructure (discussed further in Section 1.4) pose serious sustainability challenges to the augmentation of the capacity of this resource in the country.

The other conventional sources of natural gas and oil have estimated reserves of 1330.26 billion cubic meters (BCM) and at 759.59 million tonnes (MT) respectively. However, the availability of these is far from sufficient to meet the domestic demand and since 2004, India has been a net importer of crude oil and gas with imports estimated at 80.5% [of the 204.80 Million Tonnes of Oil Equivalent (mtoe)] and 28.4% (of 87.22 mtoe) at the end of the 12th Five Year Plan (Planning Commission, 2012). The oil and gas industry is marred with challenges linked to regulatory uncertainties, subsidized petroleum prices, regulated gas prices etc. which have diminished the investments in the industry subsequently leading to reduction in production[1]. While the oil and gas resources play a significantly smaller role in power generation in the country, their availability is nonetheless important to maintain the diverse fuel base required for power generation.

Hydropower has the second largest contribution to the overall power generation in India over the last few decades (See *Figure 1.1*). According to the Central Electricity Authority, the total hydro-electric potential of the country is estimated at 148701 MW (CEA, 2008) with additional 94000 MW that can be augmented through Pumped Storage Schemes. As against this potential, the total installed capacity at the end of 2013 was 39788.4 MW. During the 12th Five Year Plan the capacity addition in the hydro-power sector is estimated at 30,000 MW. Compared to other conventional sources, large scale hydropower projects, have a longer gestation period, however unlike the other sources the cost of generation is relatively inflation free in the long run. It is also considered benign with respect to its impacts on climate change as opposed to conventional sources. However, the development of hydropower in the future will be subject to addressing the key challenges linked to not only obtaining regulatory clearances in time so as to capitalize on the benefits linked to lower power generation costs but also dealing with the ecological impacts associated with dam development.

(1) India is increasingly finding it difficult to commercialize its oil and gas discoveries. Since the introduction of NELP in 1999, there have been 60 discoveries, out of which 51 are gas discoveries. However, out of these 51 discoveries, only two have entered production.

Box 1.1 Specific Challenges linked to Hydropower development

The hydropower potential in India is largely concentrated in the states of Arunachal Pradesh, Uttarakhand and Himachal Pradesh. These states are also rich in biodiversity with significant research potential on new discoveries. Dam development in this context is challenging as the government agencies and developers have limited or dated data on the ecology of these areas to ascertain impacts. There are significant data deficits pertaining to hydrology which are fundamental to undertaking feasibility studies for dam projects. Anecdotal evidence suggests that these issues result in significant delays in preparing preliminary reports, undertaking dam break studies (which are crucial to identify impacts) and subsequently obtaining clearances. Data deficit also results in misinterpretation of hydropower potential resulting in direct impacts on the economic aspects of project development. Further, limited cumulative impact assessment studies exist in these basins, and while the government has begun commissioning studies at a basin level, these require time, which in turn results in delays in project establishment.

Nuclear

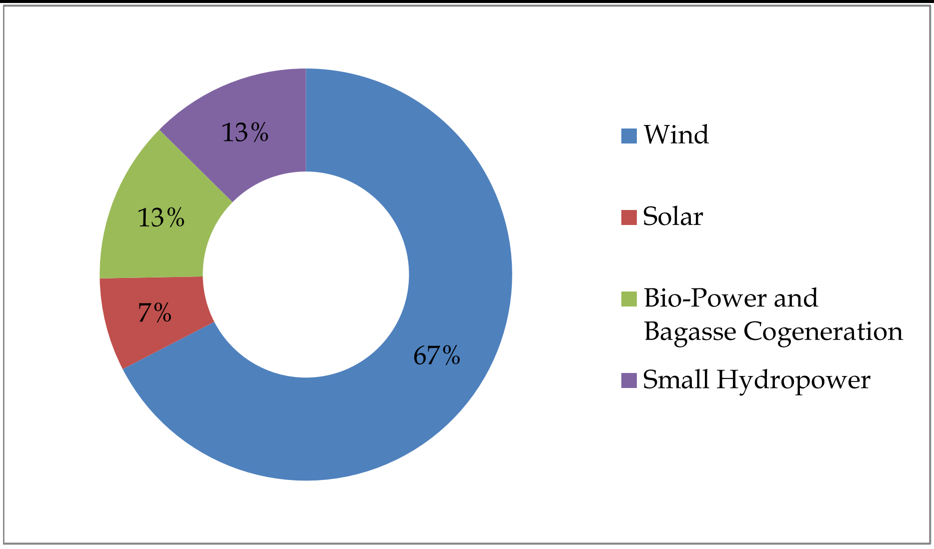
Nuclear power contributes approximate 3.53% in the total electricity generation in the country (IAEA, 2014). As of 2013, India had 21 operational nuclear power reactors and 6 under construction generating approximately 30292 Gigawatt Hours of electricity (ibid). Nuclear Power Corporation Limited has drawn up a plan to augment the nuclear power capacity to 63,000 MW in 2032 (Economic Times, 2010). Nuclear power forms a major source of energy for the country as indicated in the Integrated Energy Policy, 2006; however the growth of this sector has been hampered predominantly due to community protests (such as in Jaitapur and Kundakulam) due to potential safety concerns.

Renewable Energy Sector

According to a United Nations Environment Programme 2013 Report, the largest shares of investments in renewable energy have occurred in Brazil, China and India, which together account for almost US $ 60 billion (UNEP, 2013). India ranks 5th globally in terms of installed capacity from wind energy projects. The total potential for renewable power generation in the country as on March 2012 is estimated at 89774 MW, which includes wind power potential of 49130 MW (54.73%), SHP (small-hydro power) potential of 15399 MW (17.15%), Biomass power potential of 17,538 MW(19.54%) and 5000 MW (5.57%) from bagasse-based cogeneration in sugar mills (CSO,2013). The renewable energy capacity is virtually concentrated in five states- Rajasthan , Gujarat, Maharashtra, Karnataka and Tamil Nadu, of which Gujarat, Tamil Nadu and Rajasthan put together have 70% of the wind generation capacity and 91% of Solar generating capacity in the country (CEA, 2013 a).

At present, the renewable sector contributes 12.20% or 228,271.73 MW of the total installed capacity of power in the country. Amongst the renewable energy sector, wind is the most dominant accounting for 67% of the total power generation, followed by small-hydro power, Figure 1.4 (Ministry of Power, 2014) provides details of the current installed capacity in the renewable sector and the subsequent sections provide a brief overview of each energy source and the key challenges therein.

Figure 1.4 Distribution of Installed Capacity of Renewable Energy Sources as on 2013



Wind Power

Wind power has emerged as the most promising renewable energy source in India. While the estimate potential is concentrated in Gujarat, wind power installations are led by Tamil Nadu, followed by Maharashtra and Gujarat. The state-wise estimated and installed capacity for the eight major renewable energy endowed states is presented in Table 1.1 (according to the Centre for Wind Energy Technology).

Table 1.1 State-wise wind potential and installed capacity (MW) as on January 2014

State	Estimated Potential (MW)	Installed Capacity (MW)
Tamil Nadu	14152	7251
Gujarat	35071	3384
Maharashtra	5961	3427
Karnataka	13593	2212
Rajasthan	5050	2734
Madhya Pradesh	2931	386
Andhra Pradesh	14497	648
Kerala	837	35

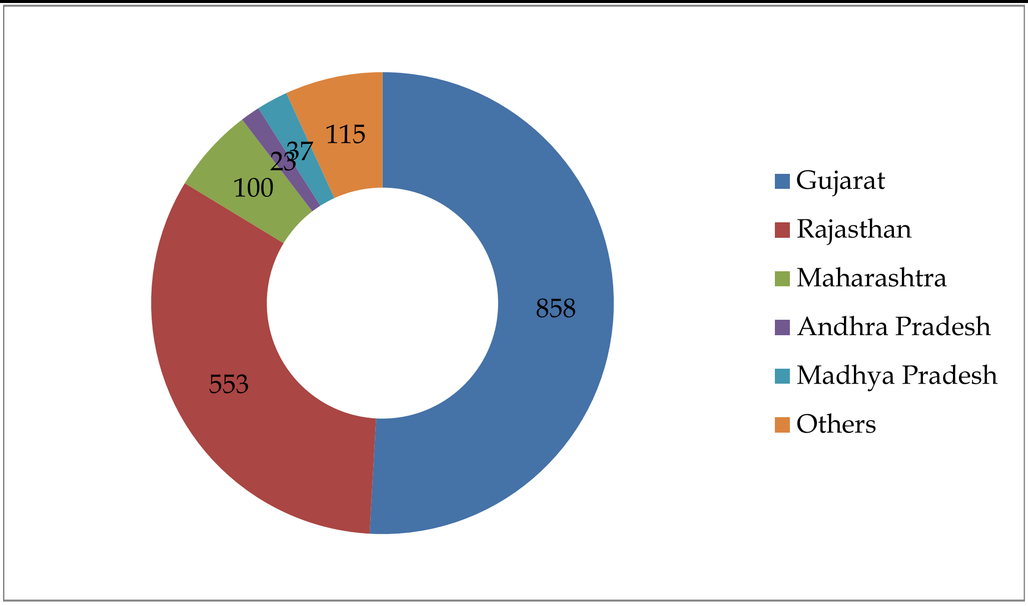
This sector is also attracting greater interest from investors and in 2012, wind energy attracted nearly US $ 3.4 billion, or almost half of the total investments in clean energy in India. While wind power development, under the overall ambit of renewable power development, has received significant policy support, the key challenges for the augmentation of this source lie in obtaining land and developing the supporting infrastructure (such as access roads and power evacuation systems).

Solar Power

While endowed with abundant radiation, solar energy is still largely underutilized in the country. To augment the generation of solar power, Government of India launched the Jawaharlal Nehru National Solar Mission

(JNNSM) to install 20000 MW of power by 2022. The government has also set up Solar Energy Corporation of India (SECI) to assist MNRE in achieving the objectives of JNNSM. Solar power capacity has witnessed a rapid growth over the last few years to reach 1686 MW (as on March 2013) (MNRE, 2014) with Gujarat and Rajasthan leading the total power generation via this source [See Figure 1.5 (MNRE) below].

Figure 1.5 State-wise split of solar power projects as on March 2013



Similar to wind power development, this sector faces limited regulatory hurdles, if any. However, being land intensive, obtaining the requisite land parcels may pose a challenge in speedy development of this sector. Further, the lack of adequate power evacuation infrastructure will limit realization of the potential linked to solar power, and while there has been some progress in off-grid power systems, this in itself will be challenging in the long run due to the resultant requirement for power storage systems (such as batteries) that are hazardous in nature (and do not currently have any regulatory provisions linked to their management).

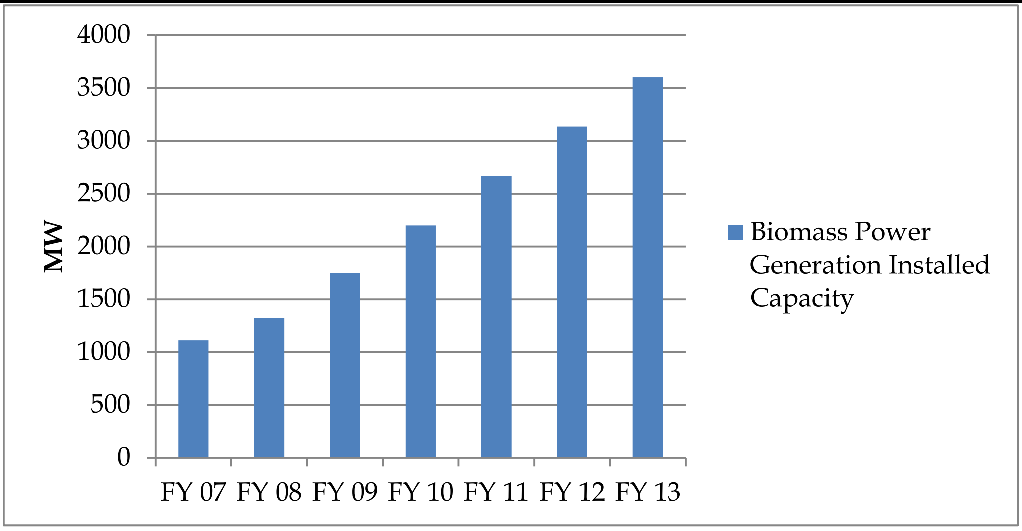
Another issue peculiar to the solar sector is the ongoing debate regarding the dumping of solar panels at the end of their life-cycle. In the absence of clear guidelines, the developers are either do not take responsibility for managing the panel dumping or are too wavy to invest in light of potential regulatory changes with regards to dumping. While this issue has impacted solar power development to a limited extent in India, given the global experiences, it begs further inquiry.

Biomass

Biomass contributes more than 14% of the Global Energy Supply and it provides 32% of the total primary energy consumed in the country (E&Y, 2013). Biomass availability is estimated at about 500 MT/year, of which 120-

150 MT is available for power generation (ibid). MNRE has estimated that approximately 18000 MW of power can be generated from agro-based residues, including agricultural and forestry residues. The highest estimated potential is concentrated in Punjab and Maharashtra closely followed by Uttar Pradesh. The total grid-interactive installed biomass capacity in India reached 3601 MW (in March 2013) led by Uttar Pradesh, Maharashtra, Tamil Nadu and Karnataka (MNRE, 2014). Figure 1.5 illustrated the growth of biomass-power generation in India (E&Y, 2013). Of the total installed capacity, 1265 MW was through cumulative biomass power generation and 2337 MW through bagasse cogeneration (MNRE, 2014).

Figure 1.1 Growth of Biomass-based power generation in India



The most critical bottlenecks in development of biomass based energy include supply-chain related issues i.e. non-availability of feedstock and a related issue linked to the volatility of prices. These issues impact a degree of uncertainty to investments in this sector, which has a negative impact on project development (and viability in case of ongoing projects).

Small Hydro

Hydropower projects under 25 MW are classified as small-hydro power projects (SHPs) and categorized as a renewable resource. As per the Ministry of New and Renewable Energy estimates, the renewable energy potential of SHPs is set at 19749 MW with over 50% concentrated in Himachal Pradesh, Uttarakhand, Jammu & Kashmir and Arunachal Pradesh. The government has attracted the private sector to invest in such projects and by the fact the 656 projects of the 967 SHP projects [aggregating to 3671 MW (MNRE, 2014)] in the country are being developed by the private sector, it can be assumed that the growth of this sector is by and large subject to private investments.

However, in the light of limited cumulative studies at the basin level (as discussed earlier), the development of these projects is subject to completion of such studies and re-estimation of the basin potential. Further, several times, these projects get held up due to clearance issues linked to larger dams in the basins (and anecdotal evidence indicates that in the absence of improper basin level feasibility studies, there have been instances where smaller dams projects have been abandoned to make way for a larger project). The delays associated with project approvals therefore add to project costs, making them unviable in the long run.

1.3 OVERVIEW OF THE OVERALL DEMAND SUPPLY SCENARIO IN THE POWER SECTOR

Despite the ongoing efforts to promote the growth of the installed capacity, the power sector in India has faced significant energy and peak demand shortages. An analysis of the energy demand and peak demand from the End of 10th Five Year Plan to 2011 indicates an average energy deficit of 9.84% and the average peak demand deficit of 13.3 % (Planning Commission, 2012) [See Figure 1.6 and 1.7]

Figure 1.6 Energy Deficits from the End of 10th Plan to 2011

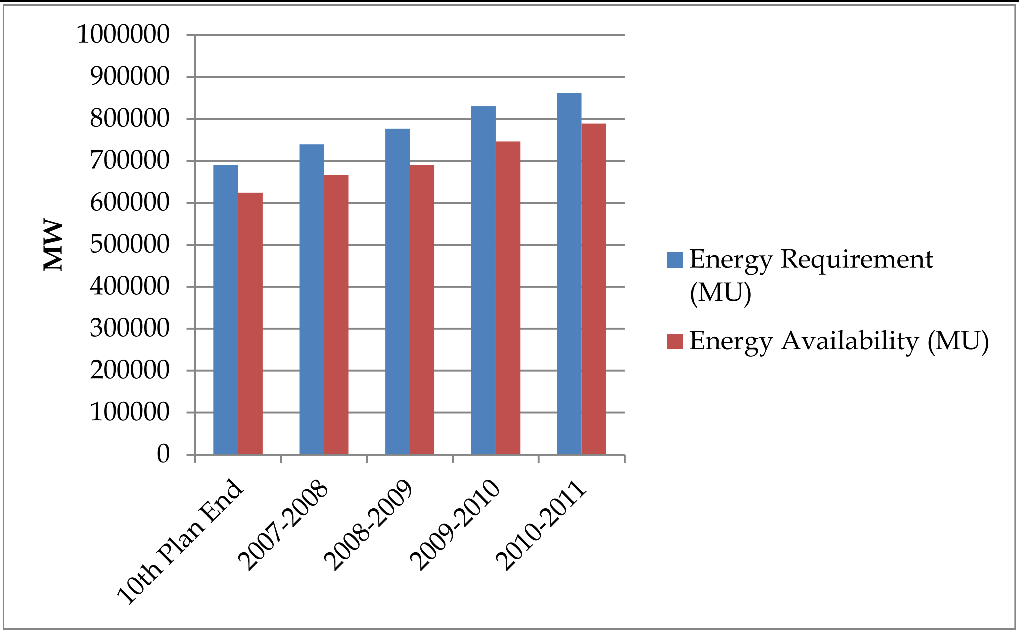
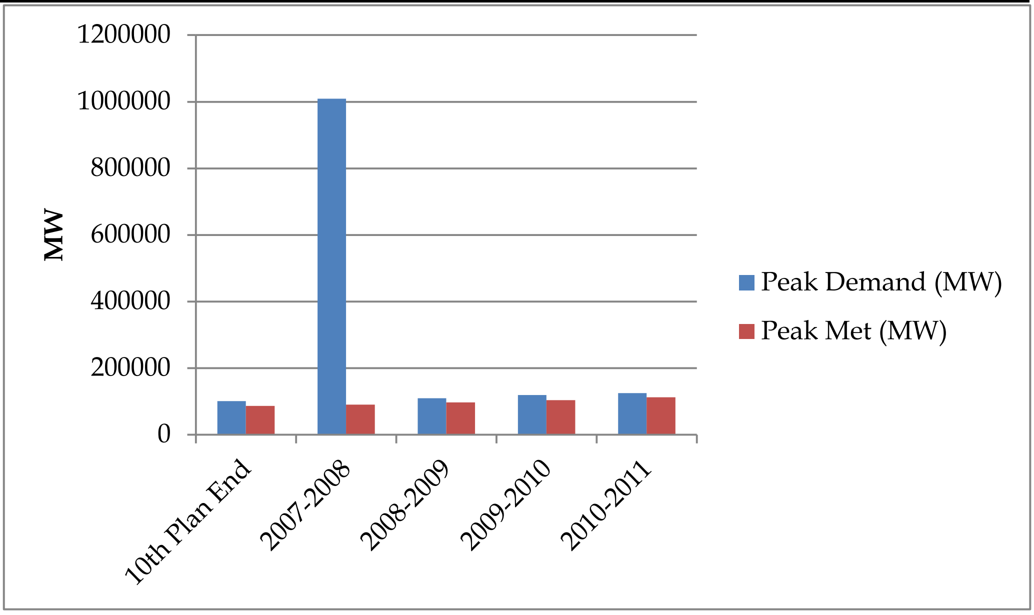


Figure 1.7 *Peak Demand Deficits from the End of 10th Plan to 2011*



With an annual electricity demand growth of 10-12%, the installed capacity inevitably struggles to catch up. Even with a planned capacity addition of 17800 MW during 2014-15, CEA estimates power deficits to prevail in the country in the order of 2% peak shortages and 5.1% energy shortages along with very high shortages likely to be experienced by Southern Region in the coming year (CEA, 2014).

If this trend continues, India will be headed towards serious energy insecurity and therefore, the existing alarm signs pertaining to energy deficits beg the need for substantial capacity additions in power generation. However such additions, made through ambitious capacity addition plans in the near future (such as an estimated capacity addition of about 76,000 MW during the 12th Five year Plan) will require addressing the most significant constraint in this sector which is fuel (Planning Commission, 2012). This in turn will require addressing the key challenges linked to the development of the power generating sources.

In such a scenario, therefore, sustainable power comes into focus as a means to tackle the power sector woes. While this term has not lacked attention in national and international discourse, it needs contextualization so that actions can be taken to operationalize it. The subsequent sections therefore discuss this concept in the Indian context and provide an overview of the key challenges and opportunities therein.

1.4 *SUSTAINABLE POWER IN THE INDIAN CONTEXT*

International focus on sustainable power largely equates to the shift towards renewable energy. This is due to the argument for promoting cleaner fuel based energy generation (to prevent climate change) whilst reducing the dependence on conventional hydrocarbons. However in the Indian context, such a simplistic view to sustainable power may not be the best option. This is not to say that the growth of the renewable sector is dismissible in the overall power generation context. In fact, India will need to develop its renewable portfolio to ensure a diverse resource base for power generation; however, in the medium term (i.e. next 25-30 years), conventional sources (specifically coal) will play a crucial role in enabling the rapid growth of the power sector as discussed subsequently.

Firstly, in the existing development scenario, conventional sources (including coal, gas, nuclear and hydro) offer the higher comparative availability and the lowest generation cost compared to renewable sources (See Table 1.2) (Banerjee, n.d). The comparative availability in this sense pertains to the reliability of production, which in the case of renewable sources such as wind and solar is subject to the overall climatic conditions. Conventional sources therefore serve as a more continuous fuel source for power generation.

Table 1.2 Comparison of Electricity Generation Options for India

Source	Capital Cost* (million/MW)	Gestation Period (Years)	Availability (Maximum capacity factor)	Cost of Generation (INR/Kwh)	Land Area (sq. m/MW)
Coal	INR 50/MW USD 1/MW	5	92%	INR 3/kWh	2000
Gas	INR 40/MW USD 0.8/MW	3	95%	INR 3.5-4/kWh	NA
Nuclear	INR 70/MW USD 1.4/MW	7	80%	INR 4/kWh	1200-4700
Hydro	INR 60/MW USD 1.2/MW	6	50-60%	INR 2.5-3.5/kWh	222,000
Solar PV	INR 120/MW USD 2.4/MW	1	25%	INR 10/kWh	12,000
Solar Thermal	INR 150/MW USD 3/MW	2	26%	INR 15/kWh	20,000
Wind	INR 60/MW USD 1.2/MW	1-2	30%	INR 4-6/kWh	100

Secondly, conventional sources have a lower capital cost per MW and similarly lower cost of generation (See Figure 1.8). Specifically in this sense, given the poor performance of the oil and gas sector, coal is the most economical option available compared to other power sources and several expert reports on energy security predict that coal is likely to continue to have a share of 51% in electricity generation by 2031-32 even under the scenario where all alternative energy sources are utilized to their potential along with efficiency gains (Integrated Energy Policy 2006 and KPMG 2010). While wind power has capital cost and generation cost comparable to that of coal and gestation period, it loses out on the reliability that is offered by coal.

Finally, the land requirement per MW of energy generation for conventional sources (except hydro) is comparably lower than the renewable sources albeit with a higher associated social cost. In the medium term, therefore, the reliability, capital cost and cost of generation through conventional sources is what will be required to secure the energy needs of a growing economy like India [(1)].

Notwithstanding the economic argument for conventional sources vis-à-vis the renewable ones, it will be important to note that renewable sources, with their lower gestation periods will be able to promote energy security by allowing energy generation quicker.

This being said, sustainable power then will need to ensure that the benefits linked to each of these sources is harnessed. In that, the reliability and cost effectiveness offered by conventional sources or lower gestation period offered by renewable ones will be of no use if the challenges linked to augmentation of each of these sources are not met. As discussed earlier for example, the regulatory delays in case of coal and hydro will kill the benefits linked to lower capital costs, and these, will inevitably be passed on to the consumers in the form of higher user tariffs.

Therefore, in the Indian context, to be more than just a buzz word, sustainable power will need to encompass more than just renewables to the more conventional energy sources. It will need to address these key challenges linked to land, regulatory clearances, infrastructure and the environmental and social costs, rather than focussing on the preoccupation with the type of energy sources that will suit best to the context (which too is influenced by the international debates). It will require concerted efforts on part of all stakeholders to devise strategies that can address these challenges. Sustainable power will mean that we ensure sustainability of the sources to allow promoting energy security whilst managing the associated impacts. It will require us to think of power holistically, rather than just the end product. It will mean that we link issues of generation and distribution that have been traditionally siloed and that have resulted in critical energy deficits. Sustainable power in India will therefore mean more than just power supply sustainability, it will be sustainability of all the associated generation and distribution aspects.

In this context therefore, the subsequent sections attempt to discuss the key challenges (in order of priority) and suggest potential measures to address the same (however, it is important to note that these just offer an entry point and are by no means comprehensive).

1.4.1 *Land Acquisition, Resettlement and Rehabilitation*

Land acquisition is unequivocally one of the biggest challenges impeding the growth of the power sector (IBEF, 2013) in India. This is due to the fact that the geographies where the power generating sources are located represent some of the most socio-economically sensitive and/or biodiversity rich areas. For

(1) Which can also be corroborated by the examples of other BRIC nations as illustrated earlier.

example, coal deposits are mainly confined to the states of Jharkhand, Odisha, Chhattisgarh, West Bengal, Andhra Pradesh, Maharashtra and Madhya Pradesh accounting for more than 99% of the total coal reserves in the country (CSO, 2013). Hydropower is concentrated in the north eastern states and wind power along forest areas.

In such cases, legacy issues linked to environmental impacts of the projects, violation of forest rights [see for example the case of Mahan coal block in Singrauli (Greenpeace, 2012)], limited local benefits and perceived livelihood impacts, result is widespread distrust among the community members and make land acquisition a critical and sensitive task (specifically for coal and hydropower). Instances of large scale displacements (see for example, displacement due to dams on Narmada), poor rehabilitation efforts and lack of payment of compensation (see for example failed rehabilitation process of Central Coalfield Limited's operations) and subsequent loss of income have resulted in impoverishment of communities that stand to gain nothing from the development of these energy projects. This is particularly acute in the case of tribal communities that have high forest dependence, traditional customs and livelihood patterns and small population sizes. [For example, hydropower development in the Dibang valley will result in the displacement of the *Idu Mishmi* tribe that comprises of only 9500 people (Vagholikar, 2010) resulting in a direct impact to the very existence of the tribe in the future.]

Further the disparity in central and state level regulations and policies and the existence of customary rights add a whole new layer of complexity to the land acquisition process. The erstwhile Land Acquisition Act, 1894 had no provision for compensation for economic displacement or consent. Even with amendments being made to the land acquisition act in 2013, its potential in addressing and streamlining issues in the land acquisition process remains yet to be known.

Way Forward

Sustainable power in this regard will therefore need to reconcile legacy impacts on the local communities and ensure fair compensation for losses (both tangible and intangible) and their involvement in the decision making processes for future projects. It will require action on part of both government organizations and project proponents to avoid inordinate delays, specifically in the context of the following:

- Obtaining prior consents from the affected communities in good faith and ensure that project benefits are shared equitably;
- Market valuation and payment of compensation as outlined in the Right to Fair Compensation and Transparency, Land Acquisition Rehabilitation and Resettlement Act, 2013 at a minimum;
- Inclusion of vulnerable groups (specifically the non-titleholders) in the rehabilitation schemes;
- Respecting the customary rights and compensating for communal land holdings along with other tangible and intangible losses;

- Delineating strategies to mitigate the impacts on the social, cultural and religious choices of the tribal communities.

More importantly, it will require approaching the issue linked to land acquisition with a certain sense of sensitivity to be able to chart actions that alleviate the impacts (both physical and emotional) linked to the resettlement process and reduce the time lag between resettlement and rehabilitation. The Sustainable Development Framework for the mining sector (ERM, 2011) is one example of a framework that proposes principles and measures to ease challenges linked to land acquisition and similar frameworks can be replicated to guide the other sectors.

1.4.2 Regulatory Challenges and Governance Issues

The multiplicity of governing agencies, clearances and licences that are required for the development of energy projects are the second major cause of inordinate delays in project execution. While renewable sector projects such as wind and solar are exempt from having to obtain environmental clearances, they are still required to obtain forest and wildlife clearances. Typically, proponents are required to approach anywhere between 2 to 10 government agencies for obtaining clearances and in cases where a particular consent or license is linked, delays on part of one agency has a cascading effect on the response time of another.

For example, anecdotal experience indicates that mere environmental approvals take approximately 10 months if everything goes smoothly and mining approvals can take anywhere between '3-7 years' (KPMG, 2010). In the case of hydropower, there have been instances where environmental clearances have taken upto 5 years from the date of filing an application and in the absence of adequate hydrological and ecological data, agencies are finding it increasingly difficult to award such clearances. In both these cases, forest clearances is a whole different issue in itself and there are examples of projects dating as far back as early 1980's that have still not received the clearances.

In the case of wind power too there have been instances of forest clearances being awarded 3-4 years after filing an application. Such delays reflect poorly on the existing governance systems that lack clear timelines to provide verdicts. The state committees typically meet once a month and even in these meetings it is unlikely that projects are guaranteed public hearings as per regulatory requirements. Forest and wildlife clearances may require proponents to undertake additional studies and there are often not stated upfront during the initial review of the applications.

In case of renewable sector, this is particularly pressing as their benefit of having a shorter gestation period is deemed redundant. In spite of the implementation of a single window clearance system in most states, the onus of obtaining a clearance is on the developer rather than the state nodal agency (Krithika and Mahajan, 2014). There have also been issues linked to transparency [1] (see for example the well-documented Coal scam) which has directly impacted investor confidence.

Such issues have overall resulted in project execution delays and escalation of project costs making them unviable for developers [2].

Way Forward

Sustainable power will need to ensure the capitalization of the benefits linked to each of these power generating sources to avoid cost escalations and going forward the following measures will need to be considered:

- Streamlining of all regulatory process and ensuring time-bound award of clearances;
- Creating an automatic approval system in case of failure of the state to provide a verdict in time;
- Increasing the frequency of meetings of the state level regulatory authorities to avoid delays in conducting additional studies/public hearings;
- Ensuring greater transparency in allocation of projects and funds by making the decisions and basis for those decisions publicly available;
- Undertaking consents from Gram Sabha and affected communities through a fair process.

While it is known that the new government precisely aims to reduce such regulatory bottlenecks, these will need to ensure that adequate consideration are provided to addressing impacts linked to these projects. There will need to be a greater synchronization between the government departments to operationalize any changes to the regulatory systems. Finally, there will be a serious need to revisit national level policies that guide development in the power sector such as the Integrated Energy Policies to incorporate global trends in fuel use for power generation.

1.4.3 Socio-Environmental Issues

Conventional energy sources are linked to significant and largely well-known socio-environmental issues. These are related to rise in air emissions, impact on water resources, land degradation, forest degradation in case of coal (Chikkatur and Sagar, 2007), flooding and impact on biodiversity in case of hydropower health and biodiversity related impacts due to oil and gas and overarching impact on livelihoods, landlessness, and impoverishment. Contentious issues have been raised concerning interstate water (and subsequent food) security and safety linked to these projects resulting in

(1) For example, in the case of disbursement of funds under the National Clean Energy Fund, funds earmarked for R &D have been known to cover up budgetary shortfalls of the government (Krithika and Mahajan, 2014). There have also been issues where projects have been awarded commissioning certificates even prior to completion of construction.
(2) In the case of coal for example, Ministry of coal has allotted 214 captive coal bocks to various players upto March 2010 with upto 170 having been allotted by 2007. However, only 26 of such blocks have started production by March 2010. It has been observed that there has been limited progress of the rest of the blocks on the ground indicating inadequate implementation and structuring of government policies (KPMG, 2010).

strained inter-state relations. Nuclear energy has a host of problems linked to safety, which were brought to the fore by the disaster at Fukushima.

Further, in the Indian context, discussions on issues linked to the power generation largely leave out impacts of renewable energy projects for two reasons- one, these projects are outside the preview of the Environmental Impact Assessment Process (Krithika and Mahajan, 2014) and two because these projects are popularly considered benign. The government puts forth similar views as seen through the report by Ministry of New and Renewable Energy on 'Development Impacts and Sustainable Governance Aspects of Renewable Energy Projects' (2013). Notwithstanding this fact, renewable projects are known to have significant impacts on local ecology such as those outlined in a recent Centre for Science and Environment publication titled 'Green Norms for Wind Power' (2013) and Solar PV panels may have impacts on the easement rights of individuals.

Such environmental and social issues attribute serious sustainability concerns to a project as these often come with significant business and financial impacts (not to mention impacts on investor confidence and reputational risks at large) [See for example the case of dams along the Subansiri River, impact on air quality by the Korba mines in Chattisgarh etc.]. Such issues are particularly critical in case of projects financed by international development banks and equator principle signatory financial institutions where project finance is subject to addressing such issues.

1.4.3.1 Way Forward

In the Indian context, the regulatory provisions do not necessitate the requirement for undertaking a social impact assessment study at the outset for any project (except in case of land acquisition by virtue of the new law). If such sustainability issues are to be tackled, the viability of following measures can be considered:

- Enforcing a regulatory provision for undertaking environmental and social impact assessment studies simultaneously for all power development projects (while solar and wind may have fewer impacts, separate guidelines can be drafted for the same);
- Improving the technology used in power generation (for example use of supercritical technology in the case of coal in case of coal) and creating guidelines for phasing out dated equipment;
- Linking community interventions and investments with the project impacts (rather than investing in the popular sectors) under the mandatory requirement of undertaking CSR activities;
- Reviewing the available database pertaining to environmental and social baselines and subsequently develop robust databases to ensure proper identification and quantification of impacts.

While these are only some of the measures that can be adopted, there will be a greater responsibility on part of the government to monitor ongoing projects to identify any imminent issues and impose greater penalties to defaulters.

Further, the nuclear sector will require the development of stringent health and safety standards as this source will need to be developed in the future to ensure energy security.

1.4.4 Infrastructure Needs

The power sector faces significant challenges in terms of the existing infrastructure. While the Electricity (Amendment) Act, 1998 defined transmission as a separate activity, in the macro context, transmission cannot (and should not) be delinked from power generation, as increasing power generation without the corresponding increase in transmission facilities will be baseless. For example, plants supplying electricity to state electricity boards (SEBs) under long term power purchase agreements (PPA), lost 1.93 billion units of generation due to transmission capacity bottlenecks (FICCI, 2013).

Therefore, even if sustainability in terms of generation is achieved, such infrastructure deficits will seriously compromise the energy security in India. With newer projects being planning in more remote areas, anecdotal evidence indicates that the prime reason for reduced generation is the non-availability of evacuation facilities. This is particularly challenging for the hydropower and renewable sector projects that are being constructed away from the existing grids.

Transportation of equipment for power generation is too a challenge as the road infrastructure is often inadequate and in most cases, constructing new roads poses a serious threat to the structural stability/biodiversity in the area.

Way Forward

Infrastructure development will serve as a linchpin for sustainable power development in India. In this regard therefore, significant investments will need to be made either by government agencies or private sector players in ensuring speedy development of power evacuation systems.

In the light that projects may be located in remote areas, there will need to be an impetus for the establishment of agencies that provide air-transfer facilities of large-sized equipment (which through experience, represents an enormous cost in project development).

While off-grid power storage has been cited as a possible answer to addressing the deficits in evacuation infrastructure, in light of absence of regulatory framework around waste management and a historical evidence of poor waste management, this may result in the creation of a Frankenstein monster.

Lastly, power development projects will need to be linked to corresponding plans that facilitate infrastructure development.

1.4.5 *Economic Issues*

According to the 2012 report on the Performance of the State Power Utilities, the accumulated losses of the distribution utilities stood at approximately Rs. 200,000 crore. This is indicative of the poor financial health of the state owned distribution utilities. Further, low collections and cash deficits are becoming increasing common in the distribution sector [for example, creditor delays touched 300 days in 2010 for larger distribution utilities in Karnataka, Madhya Pradesh etc. (PwC, 2012)], which in turn has impacted the financial viability of the generation and transmission sectors. The losses of distribution utilities are expected to touch Rs 1.16 trillion by 2014-15 (IBEF, 2013).

Government of India opened up the power sector to private sector investment with the passing of the Electricity Act, 2003. The National Tariff Policy, 2005 formulated subsequently mandated that, "All future procurement of power by the distribution utilities and all future investments in inter-state power transmission would be through competitive bidding route from January, 2011." This was a fundamental change for a largely conservative sector, and was viewed as a means to promote a more competitive market. However, competitive bidding has brought to light its own set of issues regarding companies quoting lower than regulated tariffs for a 25-35 year generation without sufficiently covering/hedging associated risks linked to cost of fuel, raw materials, equipment etc. As a result, there are increasing numbers of examples where companies have failed to develop projects at the quoted tariffs due to escalation in raw material prices. This has a serious impact on the financial sustainability of the sector.

Further the Electricity Act, 2003 and National Tariff Policy, 2005 mandate Central and State Electricity Regulatory Commissions to source a certain percentage of power through renewable sources [(1)]. However weak enforcement of the same on part of the government has resulted in an uncertainly in the Renewable Energy Certificate trading (which has seen trading at floor prices) and has had an overall impact on the renewable energy market.

Way Forward

Sustainable power development will require addressing such economic issues that result in impacts on investments in the power generation sector, power generation and distribution costs and overall end-user affordability. What this means is that, there will need checks and balances that will need to be put in place to ensure economic sustainability. Some of these measures will need to include:

(1) National Action plan for Climate Change has also recommended increasing the share of renewable energy in the total grid purchases by 15% by 2020

- Reforms of the pricing and repayment mechanisms where a balance will need to be created between the cost of power generation and end-user tariffs, penalties on creditor delays etc.;
- Formulation of specific guidelines for competitive bidding processes where risks related to inflation and uncertainties pertaining to fuel imports are adequately incorporated and clear penalties are laid out for developers that do not take these into consideration;
- Stricter enforcement of RPOs to support the growth of the renewable energy sector;
- Reduction in the import dependencies for fuel that directly impact the forex reserves and development of a larger international supplier base to prevent sudden economic shocks;

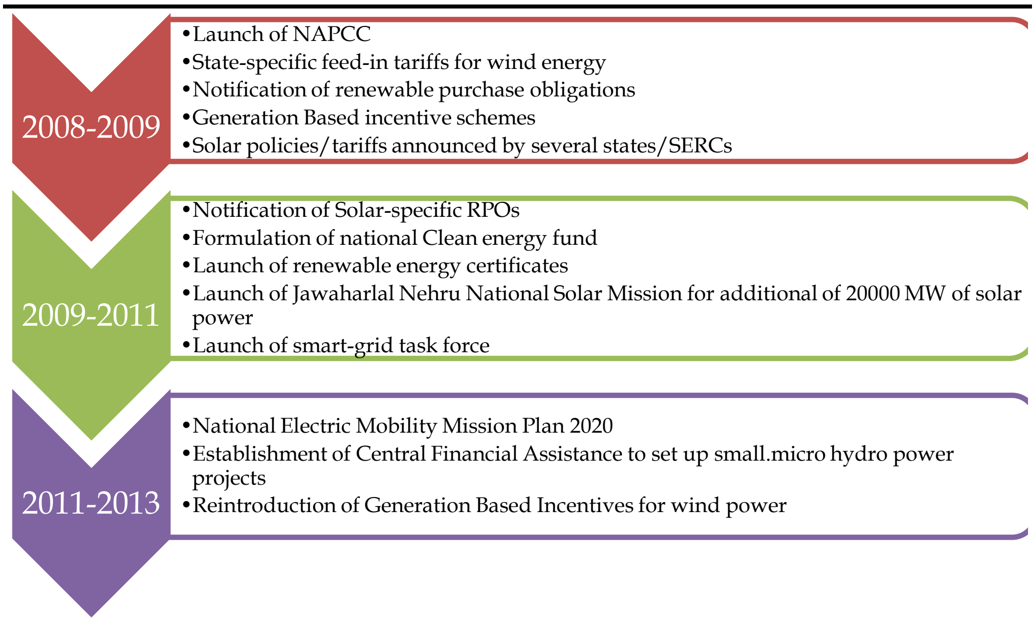
This will also require action on part of the government to restructure the incentives that are currently provided to energy exploration to cover a larger resource base (and not just oil and gas).

In sum, sustainable power for India will mean balancing economic, environmental and social considerations along with ensuring sustainability of not just the energy production but also transmission and distribution.

1.5 OPPORTUNITIES FOR SUSTAINABLE POWER

While challenges do exist for the development of sustainable power in India, this does not translate to the situation being entirely bleak. The government is taking active measures to develop the power sector through provision of incentives and favourable policy measures. In the case of renewable power, the government has increased the allocation of funds from Rs. 40680 Million in 2007-2012 to Rs. 191130 Million in 2012-2017 (Press Information Bureau, 2012). Along with the implementation of policies to promote the renewable energy sector (See Figure 1.9), the government has also undertaken several fiscal and financial initiatives such as capital/interest subsidies, generation based incentives, accelerated depreciation, 10 year tax holiday, concessional excise and custom duties for large scale generation of renewable energy. In the long run, these will ensure bolstering the role of the renewable sector in the country's energy portfolio.

Figure 1.9 Policies for the Promotion of Renewable Power Generation



While the existing coal imports are largely from Indonesia, South Africa and Australia, India is exploring new avenues such as Mozambique and Colombia for ensuring long term sustainable supply of the resource. Though nuclear power has taken a backseat in the national discussions on power sector development, recent progresses in this sector look promising (for promoting the growth of the power sector) since India received a waiver from the Nuclear Supplier Group in September 2008 which enabled the commencement of international nuclear trade, private companies secured exploration contracts in other countries and a discovery of one of the world' top 20 uranium reserves was made in the southern part of Andhra Pradesh in 2011.

Hydropower development has received a thrust due to national schemes such as the 50,000 MW Hydroelectric initiative as well as policy support through the development of projects on a public-private partnership basis (See for example hydropower policies in Arunachal Pradesh). The 12th Five Year plan also aims to development ancillary infrastructure for the development of hydropower in the remote areas (CEA, 2008).

With an aim to develop the unconventional energy portfolio, Government of India has taken several measures to utilize the untapped hydrocarbon reserves of shale gas and coal bed methane. Government of India signed an MoU with the US Geological Survey, Department of State in November 2010 to obtain technical assistance for characterization and assessment of shale gas resources, carrying out of technical studies and training of manpower (Deloitte, 2013) and a subsequent policy to develop this reserve is in the pipeline. The bidding for coal bed methane reserves has already begun and there are also ongoing discussions revolving around the development of geothermal reserves in India.

1.6 *FINAL COMMENTS*

While not without its popular mass appeal, Sustainable power in India can and will have a major role to play in ensuring energy security. It will mean ensuring sustainability of the whole power generation and distribution systems in their entirety and addressing some of the most sensitive and systemic issues linked to poor governance, land, environment and community. It will require balancing aspects linked to diversity (of sources and suppliers) with affordability and ensure reliability of support services. It will need the reviewing of policies and regulatory issues in light of the global trends and implementation glitches to allow the formulation of efficient systems. Sustainable power is therefore not only about the improving the material development of power, but also addressing some of the intangible issues faced by the sector at large.

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