Political Economy of Energy Policy in India: Electricity and LPG

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Abstract

Clean energy is key to good quality life, effective production, productivity enhancement and innovation. India has abundant coal and renewable energy, matured technology and institutions for meeting the clean energy needs of lighting, cooking and other utilitarian and productive requirements. Over the years, the country's energy consumption has become highly skewed towards fossil fuels. In addition to high-grade coal for steel and power production, India's oil and natural gas needs are mostly met through import. Geographically, there is wide disparity in energy consumption, with some regions (eastern and north-eastern states) having a larger share of primary commercial energy resources, but consuming much below average quantity of clean energy.

India's energy intensity has shown a declining trend (1.3 per cent per annum during 2005–2013) as a consequence of service sector led growth focus on energy conservation and rational use of energy. Emission intensity showed a declining trend till 2009–2010, then increased marginally, primarily due to massive rural electrification and improved quality of life. With the adverse environmental consequences of fossil fuel powered electricity generation and large hydropower production, the direction of energy policy has changed, albeit slowly, towards renewable, primarily solar. Additionally, with the government's thrust on LPG for cooking in rural areas, emission intensity will further decline. Given that renewable energy resources are almost uniformly distributed across the country, it is surprising that the energy policy has not changed track towards decentralized production. By 2030, the goal is to have a non-fossil power generation capacity of 40 per cent, and reduce the emission intensity of the economy by 35 per cent (measured against a baseline of 2005).

India's energy plans since independence have been primarily growth-oriented, with state-specific utilitarian rural electrification in the case of powerful political constituencies. The interests of the excluded - including women, excepting pious intentions, hardly got their due place; they were taken care of by specific programmes, with mixed results. Their interests were not mainstreamed.

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India's energy mix is 65 per cent commercial and 35 per cent non-commercial. The commercial energy mix in 2013–14 was coal (41 per cent), oil and gas (39 per cent), and renewable and nuclear (20 per cent). Since the country has large reserves of coal, hydro and other renewable energy resources, but a scarcity of oil and gas, and difficulty in accessing nuclear technology and fuel, policy has been directed towards coal and renewable energy f or energy security. As far as electricity is concerned, large-scale hydro-electric power plants have huge environmental consequences, and require a long gestation period and high initial investment. As a result, both public and private sector companies find it convenient to move to thermal power generation. Additionally, excess capacity to manufacture power plant equipment in China, credit facility from international financial institutions and reliable supply of high quality coal at reasonable prices from Australia and Indonesia have facilitated the growth of the thermal power plant in the country.

After nearly seven decades of independence, as on 30 September 2017, there were 40.46 million unelectrified households in the country. Only Uttar Pradesh and Bihar contribute to 52 per cent, and along with Assam, Jharkhand, Odisha, Madhya Pradesh and Rajasthan together they share 90 per cent of unelectrified households in the country. The electrified households had to remain satisfied with daily electricity availability of less than 12 hours. As on 31 March 2015, there were 64.8 million households without LPG connections, thus depending primarily on unclean biomass fuel.

In the given political context, the government, both at the national and state level, had determinedly planned to provide '24x7 Electric Power for All' and 50 million LPG connections to women heads of Below Poverty Line (BPL) families by 2019 with associated subsidies. Long-term availability and affordability of clean energy for the underprivileged sections can be ensured if they are taken up in the economic spiral through sustainable income generation programmes in convergence mode.

Towards this end, alternative strategies are available to provide affordable clean energy in an inclusive and sustainable manner. It will call for decentralized production of clean energy from locally available primary energy sources, local distribution with or without central grid connection, local value addition, and local market creation by local institutions. Such a system, in addition to reducing transmission and distribution losses, will provide pollution-free local energy security while facilitating a socio-economically, politically and technologically empowered community. Of course, it will not meet the political–economic interests of big business and politicians located far away from the grassroots. And this is the main challenge - especially for the economically underprivileged communities (including excluded) - in the future.

In India, the upward climb on the clean energy ladder from kerosene to electricity for

lighting is primarily due to accessibility and affordability. There is no specific evidence that this is out of consideration for reducing women's household drudgery or improving quality of life. The transition to cleaner cooking fuel, say from biomass to LPG, is, however, significantly related to gender- and context-specific energy resource availability and socio-economic factors. Hence, to ensure a gender-sensitive energy policy for the country, there is a need to reorient monitoring and evaluation protocols to reflect gender concerns in energy programmes, linking women's empowerment with energy development, and making cooking fuel available and affordable (through sustainable livelihood security) within proximity of the habitation.

1. INTRODUCTION

India's per capita energy (606 kg of oil equivalent in 2013) and electricity (1010 kWh in 2014) consumption is less than one-tenth of per capita consumption of developed countries. The disparities in urban vs rural; southern, western and northern regions vs eastern and north-eastern regions; and higher income vs lower income households are very high. Unfortunately, those regions where large fossil and renewable energy sources are available have lower per capita energy consumption.

Given the country's over dependence on coal, difficulty in meeting the financial burden of importing large volumes of oil and gas, environmental consequences of energy production, transformation, transportation and use, India needs to chalk out strategies for development without resorting to the level of energy consumption of developed nations. To improve the quality of life of Indian citizens, there is no doubt that per capita energy consumption has to increase. Through a judicious approach, higher quality of life can be achieved with a moderate increase in energy consumption.

India needs to change its emphasis away from non-renewable energy. Such a change in strategy calls for a paradigm shift in our development approach, i.e., from unsustainable growth-oriented economic development to environmentally friendly equitable development. Since three most serious environment related problems (global warming, acid rain and ozone layer depletion) owe their origin to energy, it is in our interest to minimize 'energy want' without sacrificing 'energy need' for a decent quality of life. A time-bound plan is essential to move to a 'renewable energy dominant decentralized system' from the existing 'non-renewable energy focused, fossil fuel-centric centralized system'.

This paper addresses energy policy with a focus on regional disparities in modern energy supply (electricity and LPG) and poor outcomes in modern energy use by women. Section 2 begins with a discussion on energy sources, uses, scarcity and disparity, and goes on to examine country-wise electricity uses, scarcity and disparity in consumption. The development of energy policy in general is dealt with in Section 3, and electricity policy in particular in Section 4. The discussion encompasses structural factors, key actors and strategies since independence, but with a focus on the post-liberalization period. Section 5 covers LPG demand and supply. Both Sections 4 and 5 cover the changing role of stakeholders, regional disparity, and the consequences of realizing inclusive clean energy security. An attempt is also made to bring women into the ambit of an inclusive energy policy.

2. ENERGY SOURCES, USES, SCARCITY AND DISPARITY IN INDIA

Energy used can be broadly divided into commercial and non-commercial usage. Commercial energy, i.e., traded in the market, includes coal, oil, gas, electricity and, in some cases, biomass. Non-commercial energy includes mostly biomass that is used for cooking, predominantly by rural communities. In 2000, India's energy mix was 65 per cent commercial and 35 per cent non-commercial (TEDDY, 2010: 2). Accurate and more recent data on non-commercial energy use in the country is not available.

Considering the stage of transformation, energy can also be classified as primary (coal, crude oil, natural gas, water, geothermal, wind, solar heat, biomass, etc.), secondary (steam, chilled water, petrol, diesel, biogas, hydroelectricity, solar electricity, etc.) and tertiary (electricity). Since primary energy is often not clean and inconvenient to use, it is transformed to a higher level that calls for sophisticated and often expensive technology. A number of political, economic, social, technological, legal and ecological factors play a critical role in ensuring access to and use of the right quantity and quality of energy by the population.

Table 1 indicates the energy reserve and annual production of primary energy. Although India has enough coal deposit, it has to depend on import for high-grade coal used in steel plants and some power plants. Seventy-nine per cent of oil demand is imported, putting a huge burden on the economy and associated insecurity. The reserve-to-production ratio for coal, lignite, oil and gas are, respectively, 532, 98, 20 and 41 years. The country's uranium deposit is low and of poor quality. The technology for using thorium needs to mature. There is a plan to develop 20,000 MW of nuclear capacity by 2020. Although India has great potential for renewable energy exploitation, there is a wide gap between potential and actual utilization. Technological constraints in a few areas, high cost of production, weak institutions and policy measures are hampering large-scale use of renewable energy.

Energy Uses

Total commercial energy use in India in 2011–12 was 353.01 Mtoe. Energy use in industry, transport, residential and commercial, agriculture, other energy use and non-energy use (fertilizer, petrochemical, etc.) were, respectively, 45.4, 21.7, 13.8, 6.2, 4.3 and 8.8 per cent (TERI, 2014–15: 3). In 2013–14, provisional energy intensity of India was 0.4192 Mega Joules/rupee, and per capita energy consumption was 19522.2 Mega Joules

(CSO, 2015). Energy consumption in the country increased from 124.9 Mtoe in 1990–91 to

314.4 Mtoe in 2010–11, nearly 2.5 times. It was slower than the rate of economic growth over the same period, with GDP 3.6 times. The GDP at 2000 prices increased from USD 270.5 billion in 1990 to USD 971.5 billion in 2010, registering an annual average growth rate of 6.6 per cent in real terms (*Economic Times*, 18 August, 2011).

Table 1: Primary Energy Reserve and Production Level

Type	**Reserve**	**Annual Production**	**Geographical Distribution**
Coal	301.05 billion Ton	565.77 million Ton	Jharkhand, Odisha, Chhattisgarh, West Bengal, Madhya Pradesh, Andhra Pradesh and
Lignite	43.24 billion Ton	44.27 million Ton	Tamil Nadu, Rajasthan
Oil	762.74 million Ton	37.70 million Ton	Western Offshore and
Gas	1427.15 billion cubic meter	34.64 billion cubic meter	Eastern Offshore and
Biomass[2]	666.5 million Ton/year (Generation) 249.2 million Ton/Year	5941 MW as on 31 March 2016	Maharashtra, Gujarat, Haryana, Punjab, Tamil Nadu
Biogas		47.52 lakh units as on 31 March 2014	Maharashtra, Andhra Pradesh, Karnataka, Uttar Pradesh,
Wind	1,02,772 MW	22,645 MW in 2014-15	Andhra Pradesh, Tamil Nadu, Karnataka,
Solar	7,48,000 MW	3,744 MW as on 31	Entire country
Hydro[3]	Small Hydro: 19,749 MW Large Hydro: 84,000 MW at 60% load factor	Small Hydro: 4,055 MW Large Hydro: 36,000	North Eastern States, Himachal Pradesh, Jammu and Kashmir,

Note: Data for coal, lignite, oil, gas and hydro are as on 31 March 2014.
Source: 1. CSO (2015).
2. For biomass: http://biomasspower.gov.in/biomass-info-asa-fuel-resources.php
3. For hydro: https://www.pwc.in/assets/pdfs/publications/2014/hydropower-in-india-key-enablers-for- better-tomorrow.pdf

Between 1990–91 and 2010–11, the proportional shares of agriculture and residential sectors went up while those of industry and transport sectors went down (Table 2). The

changes in proportional share of commercial energy use are due to large-scale rural electrification, energization of pump sets and other machinery used in agriculture, energy-efficient measures in industry, and a shift towards the service sector.

Energy intensity shows a cumulative declining trend of 1.3 per cent per year between 2005–06 and 2013–14. During the same period, the emission intensity, measured in terms of carbon dioxide emission per rupee of GDP, decreased till 2009–10, and then increased till 2013–14 (Table 3). 'This is due in part to the shift away from bioenergy consumption in the residential sector, the rising importance of the services sector in the Indian economy and increased policy efforts directed at end-use energy efficiency' (IEA, 2015).

Commercial energy consumption in India is highly dependent on coal. It contributed to about 41.3 per cent in 2013–14. In the same year, the contribution of oil and gas was 38.7 per cent. The balance 14.5 per cent was electricity from nuclear, hydro and other renewable energy sources (ibid.).

Table 2: Final Commercial Energy Consumption (in Mtoe) in India by Sector

Sector	Agriculture	Industry	Transport	Residential and Commercia	Other energy uses*	Non-energy uses**	Total
1980/81	1.6	36.9	17.4	5.6	1.9	5.3	68.7
	2.33%	53.71%	25.33%	8.15%	2.77%	7.71%	100.00%
1985/86	2.4	49.2	21.7	8.9	2.7	7.9	92.8
	2.59%	53.02%	23.38%	9.59%	2.91%	8.51%	100.00%
1990/91	4.9	62.9	28	12.6	3.9	12.6	124.9
	3.92%	50.36%	22.42%	10.09%	3.12%	10.09%	100.00%
1995/96	8.4	77.5	37.2	15.3	6.8	14.1	159.3
	5.27%	48.65%	23.35%	9.60%	4.27%	8.85%	100.00%
2000/01	15.2	77.4	33.5	24.1	13.4	28	191.6
	7.93%	40.40%	17.48%	12.58%	6.99%	14.61%	100.00%
2005/06	15.1	96.2	36.5	32.6	18.7	17.5	216.6
	6.97%	44.41%	16.85%	15.05%	8.63%	8.08%	100.00%
2009/10	23.14	137.98	55.34	43.43	30.25	26.15	316.29
	7.32%	43.62%	17.50%	13.73%	9.56%	8.27%	100.00%
2010/11	18.7	146.72	63.39	44.09	14.33	27.17	314.4
	5.95%	46.67%	20.16%	14.02%	4.56%	8.64%	100.00%
2011/12	21.79	160.09	76.46	48.7	15.07	30.9	353.01
	6.17%	45.35%	21.66%	13.80%	4.27%	8.75%	100.00%

Source: TERI (2014-15: Table 1, Chp. 1, p.3).

* This comprises energy spent of miscellaneous uses and mining.
** Non-energy uses include only naphtha and natural gas sectors, since both these fuels are consumed as feedstock in fertilizers and petrochemicals

Table 3: Energy Intensity and Emission Intensity in India

Year	Total Commercial Energy Consumption (Peta Joules)	Mid-Year Population (million)	GDP at 2004-05 price (Rs) Crore)	Energy Consumption Per Capita (MJ)	Energy Intensity (MJ/Rs)	CO2 Emission (billion Ton)	Emission Intensity (kg of CO2/MJ)
2005-06	1514	1106	325307	13694.3	0.4656	1.3	0.0858
2006-07	1642	1122	356436	14635.4	0.4607	1.4	0.0853
2007-08	1751	1138	389663	15390.1	0.4495	1.5	0.0856
2008-09	1845	1154	415867	15993.9	0.4438	1.6	0.0867
2009-10	2123	1170	451607	18147.8	0.4702	1.7	0.0801
2010-11	2189	1186	491853	18458.6	0.4451	1.8	0.0822
2011-12	2238	1202	524753	18621.4	0.4265	1.82	0.0813
2012-13	2390	1217	548211	19640.9	0.4360	1.98	0.0828
2013-14	2407	1233	574179	19522.3	0.4192	2.07	0.0860
CAGR	5.96	1.37	7.36	4.53	-1.3	5.99	0.02

Source: 1. CSO, 2015: Table 6.3. p. 45.
2. PBL NEAA and ECJRC, 2014: Table 2.2, p. 22 and 23.

Although India has large coal reserves, it is faced with poor quality (high ash content and low calorific value), inefficient and expensive mining, environmental restrictions and poor labour relations. To reduce the demand and supply gap in oil and gas, the government has initiated steps to intensify exploration in different sedimentary basins of the country; import liquefied natural gas (LNG); and acquire equity oil and gas assets overseas. A large portion of India's hydroelectric potential remains unutilized, primarily in the north and north-east due to difficult and inaccessible potential sites, difficulties in land acquisition, rehabilitation, environmental and forest related issues, interstate issues, geological surprises and contractual issues. However, the government has taken initiatives related to life extension, uprating and restoration of large hydroelectric projects. Considering the risks involved in nuclear power plants, scarcity of fuel and strong opposition from civil society and different communities, it will be an uphill task to achieve the government's plan of developing huge nuclear capacity. Evacuating electricity from the generating stations and surplus locations has been a challenge. Open access in transmission, trading and power exchange is leading to a competitive electricity market. Renewable energy is being promoted through a number of policy instruments.

Domestic Energy Use

Domestic consumers use energy for cooking, lighting, refrigeration, air conditioning, ventilation, entertainment, water supply, etc. The sources of energy are electricity, LPG, kerosene and biomass. A key driver of domestic electricity consumption in both rural and urban areas has been increasing use of electrical appliances such as fans, televisions, refrigerators and air conditioners. Consequently, there is a decline in traditional use of biomass for cooking and heating.

In 2011–12, 96.1 per cent of urban households and 72.7 per cent of rural households used electricity as the primary source of lighting (NSSO, 2013). The proportion of urban households using kerosene as the primary energy source for lighting was 3.2 per cent or less in 10 out of 17 major states—Bihar (17.2 per cent), Uttar Pradesh (10.8 per cent), Assam (7.9 per cent), Gujarat (5.2 per cent), West Bengal (5.0 per cent), Chhattisgarh (3.6 per cent) and Odisha (3.5 per cent). The percentage of rural households using kerosene was as high as 73.5 per cent in Bihar, 58.5 per cent in Uttar Pradesh, 43.3 per cent in Assam, 36.8 per cent in Jharkhand, 32.3 per cent in Odisha, and 29.3 per cent in West Bengal (ibid.).

The percentage use of LPG as the primary cooking energy is 68.4 per cent urban households and 15 per cent rural households. Similarly, 5.7 per cent of urban households and 0.9 per cent of rural households use kerosene as the primary cooking energy. Firewood and chips are the primary cooking fuel in 67.3 per cent rural and 14 per cent urban households. Eighty-seven per cent of Scheduled Tribe households and 70 per cent of Scheduled Caste households in rural India use firewood, as compared with 57 per cent of others. In urban India, the use of LPG for cooking was relatively low among Scheduled Tribes (51.6 per cent) and also among Scheduled Castes (56.8 per cent), as compared to the all-group incidence of 68.4 per cent. This use is highest among the households of the 'others' social group (76.2 per cent) (ibid.).

To provide clean lighting and cooking energy at the household level, the government has initiated schemes such as *Rajiv Gandhi Gramin Vidyutikaran Yojana* (RGGVY) and *Rajiv Gandhi Gramin Yuva LPG Vitrak Yojana* (RGYLVY).

Agricultural Energy Use

The major commercial energy consumption in agriculture is in the form of diesel and electricity, which are used for irrigation pump sets, tractors and power tillers—1,89,56,850 electric and 67,83,552 diesel pump sets were used in the country in 2013 and 2011, respectively (TERI, 2014–15). The annual sale of power tillers and tractors in 2011–12 was, respectively, 60,000 and 607,658 units. The agriculture sector consumed 11.212 MT

of high speed diesel (HSD) in 2009–10 (19.9 per cent of total HSD consumption in India), and about 133,660 GWh of electricity in the same year (17.3 per cent of the total consumption of electricity in India). At 10 per cent efficiency gain in pumps, there would have been electricity savings of 13.4 billion kWh at the farmers' end. The gricultural sector also uses energy indirectly in the form of fertilizer and pesticide. A better package of practices such as System of Rice Intensification (SRI) can help reduce direct and indirect energy use and increase productivity.

Industrial Energy Use

Industrial energy use as a proportion of the total changed from 53.7 per cent in 1980–81; 53 per cent in 1985–86; 50.4 per cent in 1990–91; 48.6 per cent in 1995–96; 40.4 per cent in 2000–01; 44.4 per cent in 2005–06; and 46.7 per cent in 2010–11. It indicates the declining share of industry in GDP and the use of energy efficient process technology (ibid.). Between 2000 and 2013, industrial energy demand nearly doubled with the primary contribution from coal and electricity to meet the growing requirements of an energy-intensive aluminum, steel and cement industry.

Transport Energy Use

Energy use in transportation as a proportion of the total changed from 25.3 per cent in 1980–81; 23.4 per cent in 1985–86; 22.4 per cent in 1990–91; 23.4 per cent in 1995–96; 17.5 percent in 2000–01; 16.8 per cent in 2005–06; and 20.2 per cent in 2010–11 (ibid.). The slow growth of mass transport, dominance of road transport, and the aspirations of people for privately-owned vehicles result in maintaining the sector’s share of high energy consumption over the years.

2. Electricity Uses, Scarcity and Disparity

Electricity constitutes about 15 per cent of final energy consumption, an increase of around four percentage points since 2000. India constitutes around one-sixth of the world’s population, and consumes about one-twentieth of global power output (IEA, 2015). As on 31 January 2016, the total capacity of electricity installed in India was 2,88,005 MW, with a mix of 69.7 per cent fossil fuel fired thermal; 2 per cent nuclear; and 28.3 per cent hydro and other renewables. In 1947, out of a total of 4,182 GWh, the all-India electricity consumption mix was 10.1 per cent (domestic), 4.3 per cent (commercial), 70.8 per cent (industrial), 6.6 per cent (traction), 3 per cent (agricultural) 5.2 per cent (miscellaneous). In 2015, out of a total of 9,38,823 GWh, the consumption mix changed to 23.5 per cent, 8.8 per cent, 42.1 per cent, 1.8 per cent, 18.5 per cent, and 5.4 per cent, respectively (CEA, 2015a). A shift of focus from industry towards domestic, commercial and agriculture is visible.

The shifts in generating capacity addition and electricity generation from the state sector to the central and private sectors are remarkable from 200–01 to 2014–15 (Table 4). In 2001,

the installed capacity mix of these three sectors was, respectively, 62.7 percent, 9.8 per cent and 27.5 per cent. In the same year, the electricity generation mix was 55.7 per cent, 8.8 per cent, and 35.6 per cent, respectively. In contrast, in 2015, the installed capacity mix of the state, central and private sectors was, respectively, 39.9 per cent, 30.8 per cent, and 29.3 per cent. In the same year, the electricity generation mix was 38 per cent, 24.2 per cent, and 37.9 per cent, respectively. Thus, states' share came down by 22.8 percentage points in capacity and 17.7 percentage points in energy generation. There is a remarkable increase in private sector share with nominal increase in central sector share.

Table 4: Sector-wise Installed Electricity Capacity Addition and Generation

Date	Installed Capacity (MW)			Installed Capacity Share %			Gross Electricity Generation (GWh/Year)			Electricity Generation Share %		
	State	Private	Central	State	Private	Central	State	Private	Central	State	Private	Central
2001	63721	9936	27969	62.7	9.8	27.5	278980	43981	178243	55.7	8.8	35.6
2002	65512	10800	28734	62.4	10.3	27.4	290244	43116	184079	56.1	8.3	35.6
2003	66582	11351	29944	61.7	10.5	27.8	291360	48045	193288	54.7	9.0	36.3
2004	67505	12325	32854	59.9	10.9	29.2	304647	55372	205082	53.9	9.8	36.3
2005	69161	13718	35547	58.4	11.6	30.0	315365	58616	220475	53.1	9.9	37.1
2006	73235	14135	36917	58.9	11.4	29.7	327731	61763	234326	52.5	9.9	37.6
2007	73579	16713	42037	55.6	12.6	31.8	350844	66803	253007	52.3	10.0	37.7
2008	77523	20511	45027	54.2	14.3	31.5	368888	80932	272806	51.0	11.2	37.8
2009	79309	22879	45777	53.6	15.5	30.9	374209	89798	277160	50.5	12.1	37.4
2010	82905	29014	47479	52.0	18.2	29.8	380371	119918	299562	47.6	15.0	37.5
2011	87417	35450	50759	50.3	20.4	29.2	386037	140878	317833	45.7	16.7	37.6
2012	85919	54276	59682	43.0	27.2	29.9	409022	149803	364005	44.3	16.2	39.4
2013	89125	68859	65360	39.9	30.8	29.3	365812	233004	364906	38.0	24.2	37.9
2014	92265	84838	68126	37.6	34.6	27.8	350403	226245	384905	36.4	23.5	40.0
2015	95079	104122	72521	35.0	38.3	26.7	366803	281760	395102	35.1	27.0	37.9

Source: CEA (2015a).

Table 5 indicates the state-wise peak power and energy demand, supply, surplus/deficit and per capita electricity consumption in 2014–15. In the country as a whole, the power and energy deficits were 4.7 per cent and 3.6 per cent, respectively, at availability of peak power of 1,48,166 MW and electrical energy of 10,68,923 million kWh, with a plant load factor of 64.46 per cent. The worse was north-eastern region, with peak power and electrical energy deficit at 12.9 per cent and 8.7 per cent, respectively.

Jammu and Kashmir and Uttar Pradesh in the north; Telangana in the south; and almost all the states of the north-east have very high energy and power deficit. Since most of these states have high potential for electricity production, this scarcity can be controlled with the right political will and planning.

The shortage of power effects the creation of individualized backup generating capacity by domestic, commercial and industrial customers during periods of peak demand in the form of diesel generators, batteries and inverters.

Table 5: State-wise Power and Energy Demand and Per Capita Consumption (2014–15)

Region/State/System	Electricity Power Demand (MW)	Power Surplus(+)/ Deficit (-) %	Electricity Energy Demand (MU)	Energy Surplus(+)/ Deficit (-) %	Annual Per Capita Total Electricity Consumption (kWh)
Chandigarh	367	0.0	1,616	0.0	1052
Delhi	6,006	-1.3	29,231	-0.4	1561
Haryana	9,152	0.0	46,615	-0.4	1909
Himachal Pradesh	1,422	0.0	8,807	-0.9	1336
Jammu & Kashmir	2,554	-20.0	16,214	-19.1	1169
Punjab	11,534	-13.1	48,629	-1.0	1858
Rajasthan	10,642	0.0	65,717	-0.6	1123
Uttar Pradesh	15,670	-17.0	103,179	-15.6	502
Uttarakhand	1,930	0.0	12,445	-3.0	1358
Northern Region	**51,977**	**-8.3**	**332,453**	**-6.3**	
Chhattisgarh	3,817	-4.7	21,499	-1.3	1719
Gujarat	13,603	-0.8	96,235	0.0	2105
Madhya Pradesh	9,755	-0.4	53,374	-0.5	813
Maharashtra	20,147	-1.7	134,897	-1.3	1257
Daman & Diu	301	0.0	2,086	0.0	6960
Dadra & Nagar Haveli	714	0.0	5,307	-0.1	13769
Goa	501	-2.4	3,969	-0.9	1803
Western Region	**44,166**	**-2.3**	**317,367**	**-0.8**	-
Andhra Pradesh	7,144	-5.0	59,198	-4.9	1040
Karnataka	10,001	-4.5	62,643	-4.3	1211
Kerala	3,760	-4.4	22,459	-1.5	672
Tamil Nadu	13,707	-1.5	95,758	-3.1	1616
Telangana	7,884	-14.3	43,337	-6.2	1356
Puducherry	389	-10.5	2,402	-1.1	1655
Lakshadweep	8	0.0	48	0.0	657
Southern Region	**39,094**	**-5.2**	**285,797**	**-4.1**	
Bihar	2,994	-4.0	19,294	-2.8	203
DVC	2,653	-2.4	18,222	-2.7	-

Jharkhand	1,075	-1.9	7,599	-2.8	835
Odisha	3,920	-0.7	26,482	-1.6	1419
West Bengal	7,544	-0.3	47,086	-0.6	647
Sikkim	83	0.0	399	0.0	685
Andaman & Nicobar	40	-20.0	240	-25.0	361
Eastern Region	**17,040**	**-0.6**	**119,082**	**-1.6**	
Arunachal Pradesh	139	-9.4	677	-9.9	525
Assam	1,450	-13.3	8,527	-7.0	314
Manipur	150	-2.7	705	-3.8	295
Meghalaya	370	-0.8	1,930	-15.3	704
Mizoram	90	-2.2	455	-6.6	449
Nagaland	140	-8.6	688	-3.9	311
Tripura	310	-14.2	1,242	-15.6	303
North-Eastern Region	**2,528**	**-12.9**	**14,224**	**-8.7**	
All India	**148,166**	**-4.7**	**1,068,923**	**-3.6**	1010

Note: Per Capita Consumption = (Gross Energy Generation + Net Import)/Mid-Year.

Source: 1. For power and energy demand, *Load Generation Balance Report 2015–16,* Ministry of Power, Government of India, CEA, Annex II and III.

2. For per capita electricity consumption, Unstarred Question No. 897, Rajya Sabha, 07.12.2015.

The annual national per capita electricity consumption in 2014–15 stood at 1,010 kWh. All the northern states, with the exception of UP, all the western states except MP, and all the southern states with the exception of Kerala have higher than the national per capita consumption of electricity. All the eastern states, except Odisha, and all the north-eastern states have per capita electricity consumption much below the national average. This is because of the large proportion of unelectrified households and lack of energy-intensive industries. In states like Odisha, Chhattisgarh and Jharkhand, per capita electricity consumption is at a moderate level, in spite of a large number of unelectrified households and below poverty line families, because of the presence of many energy-intensive, extraction-based industries.

Over the various five-year plans, rural electrification and clean energy for cooking find their place at different degrees (Table 6).

Table 6: Focus of Rural Electrification in Different Plan Periods

Plan and Period	**Focus of Rural Electrification**	**Focus on Gender Aspects**
1st Five Year Plan (1951-56)	Support for irrigation Projects 1 electrified village/ 200 villages	No specific focus on Gender issues

2nd Five Year Plan (1956-61)	"Rural Electrification" declared as "special interest area" Proposed to cover all towns with a population of 10,000 or more. Only 350 out of a total of 856 were electrified	No specific focus on Gender issues
3rd Five Year Plan (1961-66)	Established "Rural Electrification Corporation" 30,000 villages electrified, against a target of 37,000 villages	No specific focus on Gender issues
4th and 5th Five Year Plan (1969-74 and 1974 - 1979)	focused on energization of pump sets Issued guidelines for village grind connectivity for all villages with a population of 5000 and above	No specific focus on Gender issues
6th, 7th and 8th Five Year Plan (1980-89 and 1992-1997)	Initiated programs of "improved chulhas or cook stoves", "Bio-gas plants" etc. Establishment of Ministry of New and Renewable Energy. Launched "accelerated rural electrification programme"	Concern on women health due to Cooking
9th, 10th and 11th Five Plan (1997-2012)	Launch of *Kutir Jyoti Yojana* and the Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY)	Integrated Energy Policy explicitly brought gender concerns through minimum lifeline energy use for lighting and cooking.
12th Five Year Plan (2012-17)	Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY) with major modifications in RGGVY (2014) Pradhan Mantri Ujjwala Yojana (PMUY) (2016)	Separation of domestic and agricultural feeders in rural area for providing round the clock and adequate electricity to domestic and agriculture sectors respectively. 50 million LPG connections in the name of women in BPL (Below Poverty Line) households.

Source: Krishnaswamy (2010), p. 26.

Both state and central governments have programmes to accelerate the village and household electrification process. As on 30th September 2017, there were 2917 unelectrified villages in the country, and the government has an ambitious target of electrifying them by 2018. Table 7 indicates the state-wise pace of household-level rural electrification in the country. As on 30th September 2017, states reported 404.6 lakh unelectrified households (UEHHs) out of the total 1790.8 lakh rural households in the country. Andhra Pradesh, Tamil Nadu and Kerala, Punjab, Gujarat, Maharastra, West Bengal, and Himachal Pradesh have achieved 100 per cent or nearly full electrification. About 90 per cent or more rural households are electrified in major states such as Karnataka, Telangana and Mizoram. States with more than 75 per cent rural

household electrification include Haryana, Chhattisgarh, J&K and Rajasthan. Among the laggards, Jharkhand, Bihar, UP, Madhya Pradesh, Odisha, Assam and Nagaland have to go a long way to realize complete rural household electrification.

The factors impinging on poor electrification in rural areas and low per capita consumption include lack of community consciousness and power to mobilize political will; theft of electricity, electrical conductors and coolant from transformers; administrative apathy, weak implementing agency, and inability to afford high initial cost of connection and regular electricity charges.

In spite of the push from the central government with enabling legislation, financing and technical support, some of the states have a record of low rate of electrification. It can be attributed to a strong agricultural lobby, political will and better governance at the state and organizational level. States with good agricultural productivity and higher per capita gross domestic product have performed well in providing electricity access. Additionally, states with a good track record in rural electrification had the distinction of felt 'essential need' for electricity among a large number of households, consequent social security of electrical infrastructure, and reasonably higher tariff.

Table 7: State-wise Status of Rural Electricity Supply (as on 30 September 2017)

States	Total inhabited villages as per 2011 census	Percentage of villages electrified	Un-electrified villages	Total Rural Households as per 2011 Census (lakh)	Percentage of households electrified	Un-electrified Households (lakh)
Andhra Pradesh	26286	100.0	0	112.16	100.0	0
Arunachal Pradesh	5258	78.3	1142	2.32	65.1	0.81
Assam	25372	98.7	330	51.89	53.5	24.13
Bihar	39073	99.5	206	123.42	47.5	64.84
Chhattisgarh	19567	98.8	229	45.01	85.8	6.37
Gujarat	17843	100.0	0	66.58	100.0	0
Haryana	6642	100.0	0	34.24	80.1	6.83
Himachal Pradesh	17882	100.0	0	14.7	99.1	0.13
Jammu & Kashmir	6337	98.4	100	12.91	79.0	2.71
Jharkhand	29492	98.9	312	54.8	44.4	30.46
Karnataka	27397	100.0	9	95.01	92.2	7.37
Kerala	1017	100.0	0	71.04	100.0	0
Madhya	51929	99.9	41	114	60.5	44.99

Maharashtra	40956	100.0	0	139.15	97.4	3.62
Manipur	2379	97.5	60	3.88	72.4	1.07
Meghalaya	6459	98.6	91	4.63	70.0	1.39
Mizoram	704	98.4	11	1.1	90.0	0.11
Nagaland	1400	100.0	0	1.6	45.0	0.88
Odisha	47677	99.3	335	86.61	62.3	32.63
Punjab	12168	100.0	0	36.89	100.0	0
Rajasthan	43264	100.0	0	90.03	77.6	20.19
Sikkim	425	100.0	0	0.37	86.5	0.05
Tamil Nadu	15049	100.0	0	102.84	100.0	0
Tripura	863	100.0	0	7.96	73.0	2.15
Telangana	10148	100.0	0	59.72	93.1	4.12
Uttar Pradesh	97813	100.0	2	302.33	51.5	146.59
Uttarakhand	15745	99.7	49	17.33	89.3	1.85
West Bengal	37463	100.0	0	138.25	99.0	1.32
Total (States)	606608	99.5	2917	1790.77	77.4	404.61

Source: http://www.ddugjy.in/

Quality of Electricity Service

The quality of power supply is assessed by the level of voltage fluctuation, frequency variation, surges, number of interruptions, and the average interruption hours. The sectoral variation in quality of electricity supply and tariff in different states is presented in Table 8.

There is wide disparity in the availability of electricity service in different states. In Gujarat, Himachal Pradesh and Punjab electricity in rural areas is available at all times. In all other states, electricity supply to rural areas is between 9 to 19 hours, with the median value at 11.5 hours. Hence, electricity is not available for more than 50 per cent of the time. To address the issues of temporal deficit in electrical power and energy and poor quality, consumers resort to backup sources in the form of captive power generating units and batteries. Backup power is not only an example of macro-level inefficient resource utilization, but is also expensive and consumes scarce non-renewable resources.

Himachal Pradesh, with low tariff, could provide better quality rural electricity service because of its significantly low-cost hydroelectricity source. Higher electricity availability in Gujarat and Punjab is attributed to reasonably higher tariff, a demanding rural community and political will. In contrast, Madhya Pradesh, Haryana and Assam, in spite of levying reasonably high tariff, could not ensure availability because of poor governance and a weak reform process.

It is observed that people are more than willing to pay for electricity services provided

it is reliable, as they see access to energy services and electricity as their doorway to a better future (Krishnaswamy, 2010). Hence, while ensuring ease of access to poor families, the provision of reliable electricity can command a reasonable price from the rural consumers.

Table 8: State-wise Quality of Electricity Supply (2010)

State	Supply in Rural Area (hr/day)	Lowest Domestic Tariff (Rs/kWh)	State	Supply in Rural Area (hr/day)	Lowest Domestic Tariff (Rs/kWh)	State	Supply in Rural Area (hr/day)	Lowest Domestic Tariff (Rs/kWh)
Jharkhand	11	1.5	West Bengal	11	2.27	Himachal Pradesh	24	1
Bihar	9	1.35	Madhya Pradesh	12	3.15	Punjab	24	3.11
Uttar Pradesh	13	3.45	Odisha	13	1.4	Tamil Nadu	18.7	-
Assam	11.5	2.35	Gujrat	24	2.8	Karnataka	9.5	2.1
Rajasthan	11	1.95	Haryana	11.5	2.63	Andhra Pradesh	12	1.45

Source: 1. For supply of electricity: http://www.vasudha-foundation.org
2. For domestic tariff: http://www.bijlibachao.com/news/domestic-electricity-lt-tariff-slabs-and-rates- for-all-states-in-india-in-2016.html

Cost of Electricity Supply and Tariff in Different States

Electricity tariff in different states for customers in different sectors is politically determined. In most states, agriculture and domestic consumers are cross-subsidized by commercial and industrial consumers. In a number of instances, to attract industries, states resort to subsidized electricity to them as well. The losses are made up from budgetary allocations and suboptimal investment in modernization, primarily in distribution and institution development. Hence, the electricity sector, owned and controlled by states, shows signs of poor management. Table 9 indicates the comparative picture of cost of electricity supply and revenue received from agricultural consumers, and the average from all consumers (domestic, agriculture, commercial and residential). For nearly a decade, starting from 2004–05, the subsidy to the agricultural sector has remained at about 70 per cent. In 2013–14, while 22 per cent of total electrical energy was sold to agriculture consumers, their share in total revenue was 8 per cent. Similarly, industrial consumers getting 29 per cent of energy sold, contribute 41 per cent of total revenue (PFC, 2015). Table 10 sows that in 2013–14, among the major states, a large subsidy for electricity was provided in Jharkhand (51.4 per cent), Bihar (39.3 per cent), Haryana (42.3 per cent), J&K (58.8 per cent), Rajasthan (45.4 per cent), Uttar Pradesh (56.5 per cent), Tamil Nadu (37.4 per cent) and Madhya Pradesh (41.3 per cent). Although the Electricity Act 2003 recommends gradual reduction of subsidy and regulatory commissions to oversee its implementation, it is expected that the large subsidy will increase rural

consumers' access to electricity. Odisha and Chhattisgarh can increase their rate of electrification, access to electricity and income generation potential in rural areas by considering a higher subsidy, at least to rural consumers.

Table 9: Average Cost of Power Supply and Average Revenue

Year	Cost of Supply (Rs/kWh)	Revenue Including Agriculture (Rs/kWh)	Revenue Only Agriculture (Rs/kWh)	Subsidy to Agriculture (% of Cost)
2004-05	2.54	2.09	0.7568	70.2
2005-06	2.6	2.21	0.7636	70.6
2006-07	2.76	2.27	0.7423	73.1
2007-08	2.93	2.39	0.7727	73.6
2008-09	3.4	2.63	0.8713	74.4
2009-10	3.55	2.68	0.887	75.0
2010-11	3.98	3.03	1.1975	69.9
2011-12	4.55	3.3	1.3514	70.3
2012-13	5.01	3.76	1.4867	70.3
2013-14	5.15	4	-	

Source: 1. CEA (2015b)
2. PFC (2015)

The Aggregate Technical and Commercial (ATC) Loss, an indicator of the technological and managerial capability of the distribution companies, stood at 22.7 per cent at the national level in 2013–14. In the same year, the ATC loss for the eastern, north-eastern, northern, southern and western regions were, respectively, 38.02 per cent, 33.94 per cent, 24.86 per cent, 19.08 per cent and 18.37 per cent (PFC, 2015).

Table 10: Average Cost of Power Supply and Revenue (2013–14)

State	Average Cost (Rs/kWh)	Average Revenue (Rs/kWh)	Gap (Rs/kWh)	Subsidy as a proportion of
Bihar (NBPDCL)	4.84	2.94	-1.9	39.3
Jharkhand (JSEB)	5.52	2.68	-2.84	51.4
Odisha (CESU)	3.91	3.66	-0.25	6.4
Sikkim	3.1	3.49	0.39	-12.6
West Bengal (WBSEDCL)	4.89	4.9	0.01	-0.2
Arunachal Pradesh	8.03	1.43	-6.6	82.2
Assam (APDCL)	5.14	4.15	-0.99	19.3
Manipur	5.2	2.2	-3	57.7

Meghalaya (MePDCL)	3.39	3.21	-0.18	5.3
Mizoram	6.35	2.34	-4.01	63.1
Nagaland	4.57	1.54	-3.03	66.3
Tripura	3.74	3	-0.74	19.8
Delhi (BSES Rajdhani)	6.1	6.11	0.01	-0.2
Haryana (UHBVNL)	5.53	3.19	-2.34	42.3
Himachal Pradesh (HPSEB)	4.83	4.77	-0.06	1.2
J&K	3.2	1.32	-1.88	58.8
Punjab	4.71	3.73	-0.98	20.8
Rajasthan (AVVNL)	7.14	3.9	-3.24	45.4
Uttar Pradesh (DVVN)	6.18	2.69	-3.49	56.5
Uttarakhand	3.09	3.36	0.27	-8.7
Andhra Pradesh (APCDCL)	4.9	4.2	-0.7	14.3
Karnataka (HESCOM)	4.75	4	-0.75	15.8
Kerala (KSEB)	4.8	4.92	0.12	-2.5
Puducherry	3.82	3.6	-0.22	5.8
Tamil Nadu (TANGEDCO)	6.52	4.08	-2.44	37.4
Chhattisgarh	3.43	3.15	-0.28	8.2
Goa	3.35	3.34	-0.01	0.3
Gujarat (PGVCL)	3.17	3.57	0.4	-12.6
Madhya Pradesh (MPMKVVCL)	4.89	2.87	-2.02	41.3
Maharashtra (MSEDCL)	5.34	5.22	-0.12	2.2

Source: PFC (2015).

In many states, especially in the east and north-east, the electricity sector is in a vicious cycle because of faulty pricing, poor management and technology options chosen (Table 11). A faulty pricing system leads to inadequate funds for generation, transmission and distribution infrastructure development, which results in power and energy deficit and poor quality of power. Intentionally not measuring the electricity supply at every distribution transformer end helps the vested interests in the organization, who work in connivance with the unscrupulous consumers. Consequently, consumers (from the premium segment) invest in their own energy system and resist higher prices for poor quality electricity services. The situation is worrisome in states where privatization has taken place. For example, in Odisha, private electricity distribution utilities are reluctant to invest in infrastructure development and have failed to bring down aggregate technical and commercial loss—which remained as high as 44.66 per cent in 2011-12; 42.88 per cent in 2012–13; and 39.19 per cent in 2013–14—notwithstanding the vigilance and oversight by statutory electricity regulatory authority (ibid.).

Unique social, economic and political factors characterize regional disparity in demand and supply of electricity and LPG. While in most states, domestic and agricultural consumers are underserved and unserved, in a few states their dominant influence in the socio-political sphere makes them privileged electricity customers. As Kale (2014) noted:

> The process of electrification has been conditioned by social and political contexts that vary from state to state….Where rural actors, either acted on the state from the inside, through rural political coalitions or from the outside through social movements, the state expanded rural electrification programs and lowered the cost of electricity for rural consumers. The absence of such pressures helps to account for the large swath of Indian countryside that remains unconnected to the grid.... In those parts of the country that were successfully electrified, the gains were due to neither nationalist idealism nor only technocratic plans. Instead, rural electrification occurred either when rural constituencies became politically influential in state governments or when farmers mobilized to demand a larger share of development resources.

Table 11: State-wise ATC Loss of Electricity Distribution Companies in 2013–14

Region/State	**ATC Loss (%)**	**Region/State**	**ATC Loss (%)**	**Region/State**	**ATC Loss (%)**
Delhi	14.09	Andhra Pradesh	14.77	Arunachal Pradesh	68.2
Haryana	34.33	Karnataka	22.02	Assam	30.25
Himachal Pradesh	15.13	Kerala	22.78	Manipur	43.55
Jammu & Kashmir	49.14	Tamil Nadu	22.35	Meghalaya	35.38
Punjab	17.91	Puducherry	16.18	Mizoram	32.53
Rajasthan	26.76	**Southern Region**	**19.08**	Nagaland	38.37
Uttar Pradesh	24.65	Bihar	46.33	Tripura	27.81
Uttarakhand	19.01	Jharkhand	42.17	**North-Eastern Region**	**33.94**
Northern Region	**24.86**	Odisha	39.19	**All India**	**22.7**
Chhattisgarh	23.17	West Bengal	32.05		
Gujarat	15.93	Sikkim	71.23		
Madhya Pradesh	28.03	**Eastern Region**	**38.02**		
Maharashtra	14.39				
Goa	10.72				
Western Region	**18.37**				

Source: PFC (2015).

In Maharashtra, dominant sugar cane farmers and their sugar cooperatives through direct control of political power were instrumental in getting high access to and quality of electricity at a low price. In Gujarat, the farmers' lobby could mobilize assured irrigation power and rural electrification at a fast pace. Similarly, in Andhra Pradesh, farmers' groups through indirect control of political power could ensure full rural electrification with adequate quantity and quality of electricity. In contrast, Odisha and West Bengal, with an urban-centric political power base, remains a laggard till today.

With the enactment of the Electricity Act 2003, subsequent national policies for rural electrification, government of India's financial and technical support, and inclusion of electricity for all in the election manifesto of major political parties at both the national and state level, the existence of unelectrified villages and households in the country can be solely attributed to state-specific lack of political will, weak governance and management system, low-paying capacity of the household and un-demanding rural customers. High ATC losses are an outcome of the absence of political will and lack of accountability of the utilities. Both technology and institutional mechanisms are available in the country to bring down the ATC losses to a reasonable level.

The recently announced Integrated Power Development Scheme (IPDS) for the north-east is aimed at reducing ATC losses by strengthening the sub-transmission and distribution network; metering of distribution transformers /feeders /consumers in the urban areas; and an IT-enabled energy accounting/auditing system. The *Deendayal Upadhyaya Gram Jyoti Yojana* (DDUGJY) will separate agricultural and non-agricultural feeders, facilitating judicious rostering of supply to agricultural and non-agricultural consumers in rural areas; and, strengthening and augmenting sub-transmission and distribution infrastructure in rural areas, including metering of distribution transformers/feeders/consumers.

The central government's *Ujwal Discom Assurance Yojana* (UDAY) aims at comprehensive resolution of ATC losses and other issues faced by the distribution companies which are the weakest link in the electricity infrastructure. The objectives are: to reduce ATC loss to 15 per cent in 2018–19; to reduce gap between Average Revenue Realized (ARR) and Average Cost of Supply (ACS) to zero by 2018–19; and to make all DISCOMs profitable by 2018–19 (Ministry of Power, 2015). It is expected that with the implementation of UDAY, information will be transparent, losses will be tracked comprehensively, corrective action will be taken through a participatory process, and demand-side management practices will be implemented through good governance and management systems.

3. ENERGY POLICY

A complex web of institutions steers and manages the energy sector in the country. At the helm of affairs is the National Development Council (NDC) that articulates its vision through the erstwhile Planning Commission, and presently, the National Institution for Transforming India (NITI Aayog), with inputs from different ministries. The Ministries of Power; Coal; New and Renewable Energy; Petroleum and Natural Gas; and the Department of Atomic Energy develop policies and implement the programmes through public sector undertakings (PSUs), research institutions, regulatory authorities and associated organizations at the national level. The Ministries of Road Transport and Highways; Railways; Shipping; Environment, Forest and Climate Change; External Affairs; Urban Development; Water Resources; Agriculture; Finance; and the Department of Science and Technology and state-level institutions, including regulatory authorities, facilitate, support and execute energy-related interventions. Coordination among different institutions at the state and national level has been a major challenge in the development of the energy sector. At the central level, coordination improved in 2014 by the appointment of a single Minister for Power, Coal, New and Renewable Energy, although the individual ministries themselves continue to exist as separate entities.

Considering the role of the state and federal government in energy policy making, it has been difficult to develop a coherent energy policy for the country. The central government has exclusive jurisdiction over inter-state trading and commerce, mineral and oil resources, nuclear energy, income and other central taxes. States have exclusive jurisdiction over water issues and land rights, natural gas infrastructure, and many specific areas of taxation, such as on mineral rights, consumption or sale of electricity, etc. Both state and central governments have jurisdiction over electricity and forestry, economic and social planning, and labour relations.

Energy sector investment used to get the lion's share in the outlays of the five-year plans, with public sector playing the dominant role. The Integrated Energy Policy 2008, the National Action Plan on Climate Change, and the coordination efforts of the Planning Commission in the past and NITI Ayog since 2014, and the submission of the Intended Nationally Determined Contribution (INDC) on 1 October 2015 are milestones in the country's energy policy. The broad aim of the policy is provision of secured, affordable and universally available, environmental friendly energy for sustainable development. India's energy vision remains coal - and renewable energy-centric. The key features of the emerging energy vision still retains its direction of big business-oriented centralized solutions without focus on regional and local level sustainable energy security (Box 1). The question of reliable and affordable clean energy for the underprivileged in an empowering, sustainable and gender-sensitive manner remains more in intention.

Key Drivers of Change in Energy Sector

The key drivers of change in the energy sector are fast economic growth, energy conservation and energy productivity enhancement measures, privatization, increasing household income, fast depleting biomass resources, limited domestic reserves of oil and gas; and an adverse impact on the environment of the rapidly developing urban and rural areas. The influence of civil society groups (including women's organizations) has not matched that of the bilateral and multilateral development institutions, business lobbies and the market-led development agenda of the state. The policy instruments, institutions and resources (finance, human and technology) need to address issues of sustainable practices.

Evolution of Electricity Policy and Programs in India

Electricity policy evolution in independent India can broadly be divided into two eras: pre-liberalization and post-liberalization.

Box 1: Key Features of India's Emerging Energy Vision (IEA, 2015)

- A commitment to the efficient use of all types of energy in order to meet rapidly growing demand. In the power sector, the target for renewables is 175 GW by
  2022 (including the expansion of solar generation capacity to 100 GW). The target for coal production is 1.5 billion Ton by 2020. Restricting fossil fuel imports to 10%, along with energy production and generation efficiency improvement are key to the achievement of the energy security objective.

- Focus on universal access to modern energy, including round-the-clock electricity supply to all. Energy subsidy programmes will be reoriented from price controls to direct financial transfer to the bank accounts of the economically underprivileged sections of the society.

- A drive for market-oriented solutions and increased private investment (including foreign investment) in energy, both through some energy-specific reforms (e.g. to licensing regimes), and via a general drive to simplify and deregulate the business environment.

- A pledge to pursue a more climate-friendly and cleaner path than the one followed thus far by others at corresponding levels of economic development. INDC includes the twin energy-related commitments to increase the share of non-fossil fuel power generation capacity to 40% by 2030 (with the help of transfer of technology and low-cost international finance) and to reduce the emissions intensity of the economy by 33-35% by the same date, measured against a baseline of 2005.

Electricity Policy in the Pre-liberalization Era

Before independence, the founders of modern India understood the key role that electricity can play in the development of the country. The pre-independence debate primarily focused on ownership (public vs private) of the electricity system, and the dominance of the government (federal vs state) in controlling it. During this period, the electricity system was mostly privately owned and controlled by provincial governments.

Immediately after independence, 'electricity became a conduit for the nationalist project in India, which allowed the "sights and sounds of the nation" to invade public and private spaces alike' (Kale, 2014: 26). The initial conduit of electricity into rural India was for its productive impact in agro-industries and for irrigation. Subsequently, electricity access

to households followed. The Electricity Act, 1948 brought the State Electricity Boards (SEBs) into existence, whose mandate was to develop a generation, transmission and distribution system in the respective regions. Most of the pre-existing private entities were taken over by SEBs. Electricity is included in the Concurrent List of the Constitution of India (7^{th} Schedule, List III, Sl. 38); hence, both the state and central government own responsibility for bringing in the desired interventions in policies and regulations for its growth. For nearly four decades after independence, the electricity sector comprising generation, high-voltage transmission and distribution gradually came to public ownership with increasing financing, share and control by the central government in the first two activities. The spread and consumption pattern in different states varied widely because of the interplay of central- and state-specific political, economic, social, technological, ecological and legal factors.

From the first Five-year Plan (1951–56) onwards, planners have taken a dominant position of centralized electricity generation, transmission and distribution, with very little encouragement for a decentralized system. In the 1970s and 80s, with the functioning of national-level generating companies like National Thermal Power Corporation (NTPC), National Hydro Power Corporation (NHPC), Nuclear Power Corporation (NPC), Neyveli Lignite Corporation (NLC), Damodar Valley Corporation (DVC) and a few others; and transmitting company Power Grid Corporation of India (PGCI), the issues of technical underperformance in generation and high-voltage transmission that had for long plagued the power sector was partially addressed. However, the technical, commercial and managerial inefficiencies of power distribution which remained in the hands of SEBs could not improve because of a range of political, economic and social factors.

> Managements of SEBs were fraught with unhealthy political interference, poor workforce discipline and archaic systems. SEBs' pricing policy of subsidised (domestic and agriculture) and cross-subsidised (industry and commerce vs domestic and agriculture) electricity supply made them financially sick, kept the electricity sector away from planned growth and

> brought bad management practices. To take care of the unreliable and costly electricity supply system, captive electricity generating sets have become a norm in industries, commercial establishments and agricultural sector. Thus, in addition to suboptimal investment in electricity sector, SEBs are gradually losing more and more creamy customers. The managements of SEBs, in their race to hide staggering transmission and distribution (T&D) losses (technical and non-technical), artificially increases the unmetered consumption to the priority (agriculture and rural) sector. The financial losses incurred by SEBs were made up from the state budget. With the dwindling state resources a time came when the states found it extremely difficult to support the SEBs and they became sick one by one (Panda, 2002, p 2).

Electricity Policy in the Post-liberalisation Era

Poor operating performance, lack of modernization and skilled personnel, tariff hike of central sector plants and huge accumulation of electricity charges, incoherent subsidy policy and theft led to the poor health of most SEBs. To reduce the technical and commercial losses, to improve the reliability and availability of power at reasonable cost, and to make the organizations in the electricity sector financially viable, the government in 1991 removed power from the list of activities reserved for the public sector in the Industrial Policy Resolution, 1956. The Electricity Supply Act, 1948 was amended to lift many regulatory disincentives to private investment in electricity sector. The Independent Central Electricity Regulatory Commission (CERC) and the State Regulatory Commissions (SRCs) were created through the Electricity Regulatory Commission Act, 1998, to bring in professionalism and independence in tariff fixation. Starting with Odisha, other states unbundled SEBs into separate generation, transmission and distribution companies. The amended legal framework of 1991 and 1998 facilitated private investment in generation and transmission, respectively.

Starting with Odisha, the reform that was initiated in other states faced resistance from farmers, employees and different consumer groups. After nearly two decades of reform in the electricity sector, the expected benefits in the form of acceptable Aggregate Technical and Commercial (ATC) losses, affordable tariff, high reliability, availability on demand, and accessibility to the economically underprivileged have not been realized significantly by all states. Governance and management of distribution companies, political will and bargaining power of consumer groups have been key factors in differential achievements.

The national level Integrated Energy Policy (IEP) implicitly or explicitly adapted the GNP maximizing paradigm to estimate energy demand, rather than trying to estimate the least

amount of energy needed to wipe out poverty, ensure energy security, and how best to meet it in a sustainable manner (Sharma, n.d.). The Working Group on Power in its report for the Twelfth Plan (2012) had the vision to ensure access of power to all, including the socio-economically weak, while increasing its generation. The same is planned to be achieved through the emphasis on coal, thermal, nuclear and renewable energy in a centralized manner. Although rural areas have context-specific primary renewable energy sources, there is hardly any enabling environment for their comprehensive exploitation through a decentralized solution. However, from time to time, the government launched various programmes for rural electrification. These include:

- Rural Electrification under Minimum Needs Programme (1974)
- Kutir Jyoti Yojana to provide single-point light to below poverty level (BPL) families in rural India (1988)
- Pradhan Mantri Gramodaya Yojana to electrify unelectrified villages (2003)
- Remote Village Electrification Programme through renewable energy by the Ministry of New and Renewable Energy (MNRE) (2001)
- Accelerated Rural Electrification Programme (2003)
- Accelerated electrification of one lakh villages and one crore households (2004)
- Rajiv Gandhi Grameen Vidyutikaran Yojana (RGGVY) merged all earlier programmes. The programme aimed at providing energy access to all by 2009 and at least one unit of electricity per household per day by 2012 (2005)
- Ministry of Power launched Decentralized Distributed Generation Scheme under RGGVY to electrify unelectrified villages, including those who receive less than six hours of electricity per day, through mini grids (2009)
- Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY), with major modifications in RGGVY (2014).

The growth in the electricity sector followed the development agenda of the state, with increasing central control over the years in the form of financing, electricity tariff, ownership of generation and transmission system, and finally, through the Electricity Act, 2003, creating more opportunities for the private sector.

Electricity Act, 2003

The Electricity Act, 2003 was enacted to replace the Indian Electricity Act, 1910, Electricity Supply Act 1948, and Electricity Regulatory Commission Act, 1998.

The Act liberalized generation, transmission and distribution; included penal action for theft of power; and facilitated further reform measures to strengthen the sector. To ensure universal access and rural electrification, the Act provided direction through

Sections 4 (National Policy on Stand Alone Systems for Rural Areas and Nonconventional Energy Systems), 5 (National Policy on Electrification and Local Distribution in Rural areas), and 6 (Obligations to Supply Electricity to Rural Areas.

National Electricity Policy 2005

The National Electricity Policy was developed in consultation with the state governments, Central Electricity Authority (CEA), Central Electricity Regulatory Commission (CERC) and other stakeholders to comply with the Electricity Act, 2003 (Section 3). It provides guidelines for accelerated development of the power sector, supply of electricity to all areas, and protecting the interests of consumers and other stakeholders, keeping in view availability of energy resources, and technology available to exploit these resources, economics of generation using different resources, and energy security issues. The objectives of the policy are:

- Access to electricity— available for all households in the next five years.
- Availability of power—demand to be fully met by 2012. Energy and peaking shortages to be overcome and adequate spinning reserve to be available.
- Supply of reliable and quality power of specified standards in an efficient manner and at reasonable rates. Per capita availability of electricity to be increased to over 1,000 units by 2012.
- Minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012.
- Financial turnaround and commercial viability of electricity sector.
- Protection of consumers' interests.

National Rural Electrification Policy, 2006

The National Rural Electrification Policy was developed to comply with the Electricity Act 2003 (Sections 4&5). Box 2 provides the key provisions of the policy.

Source: Rural Electrification Policy, *The Gazette of India,* 23August 2006, New Delhi.

Over the years, the definition of an electrified village has changed with changing demands of the people and government policy (Box 3).

Box 2: Key Provisions of the National Rural Electrification Policy, 2006

- Access to electricity to all households by the year 2009, quality and reliable power supply at reasonable rates, and minimum lifeline consumption of 1 unit/household/day as a merit good by year 2012.
- Off-grid solutions for villages/habitations where grid connectivity would not be feasible or not cost-effective. Remote villages with solar PV, only for lighting, will not be designated as electrified.
- State governments were mandated to develop a rural electrification plan (integrated with district development plan) within 6 months of notification of the

Act and intimate the appropriate commission.

- Certification of village electrification rests with gram panchayat.
- State governments were mandated to set up a district- level committee under the chairmanship or chairperson of the zilla panchayat and with representations from district-level agencies, consumer associations, and important stakeholders with adequate representation of women,
  within 3 months of notification of the Act.
- The district committee would coordinate and review the extension of electrification in the district and consumer satisfaction, etc.
- Panchayat raj institutions would have a supervisory / advisory role.
- Institutional arrangements for backup services and technical support to systems based on non-conventional sources of energy were to be created by the state government.

Box 3: Definition of Electrified Village

Prior to October 1997

A village is electrified if electricity is being used within its revenue area for any purpose whatsoever.

October 1997 to January 2004

A village will be deemed to be electrified if the electricity is used in the inhabited locality, within the revenue boundary of the village for any purpose whatsoever.

After February 2004

A village would be declared as electrified, if:

i. Basic infrastructure such as Distribution Transformer and Distribution lines are provided in the inhabited locality as well as the Dalit Basti hamlet where it exists.
ii. Electricity is provided to public places like Schools, Panchayat Office, Health Centres, Dispensaries, Community Centers, etc.
iii. The number of households electrified should be at least 10% of the total number of households in the village.

Source: http://www.ddugjy.in/

Recent Initiatives

In December 2014, the Government of India announced the Deendayal Upadhyay Gram Jyoti Yojana (DDUGJY) with major modifications in RGGVY. The objective of DDUGJY is to separate the domestic and agricultural feeders in rural areas to provide round-the-clock and adequate electricity, respectively. Three-phased power to agriculture with the required subsidy can be supplied in a prefixed time for a predetermined period, thus ensuring both energy and water economy. By separating the agricultural feeder, 24-hour electricity can be provided for domestic use with the right quality and quantity.

Additionally, it works to strengthen sub-transmission and distribution infrastructure, including metering at all levels in rural areas. Micro-grid and off-grid distribution networks and rural electrification, already sanctioned under RGGVY, are merged within its rural electrification segment.

The Rural Electrification Corporation (REC), set up in 1969, is the nodal agency for the operationalization of this scheme, and the distribution companies are eligible for support from the Ministry of Power. The grant portion of the scheme is kept at 60 per cent for non-special category states (up to 75 per cent on achievement of prescribed milestones) and 85 per cent for special category states (up to 90 per cent on achievement of prescribed milestones). The contribution of the distribution company has to be a minimum 10 per cent and loans can be 30 per cent. There is provision for additional grant, subject to conditions: timely completion of the scheme, reduction in ATC losses as per the trajectory, and upfront release of subsidy by the state government. All north-eastern states, including Sikkim, and Jammu & Kashmir, Himachal Pradesh and Uttarakhand are included in the special category.

Uphill Task for the Future

Although the Electricity Act, 2003 called for 'electricity to all households by 2009' and 'minimum lifeline consumption of 1 kWh/household/day as merit good by 2012', the country has miles to go before this goal is realized. This is clear from the fact that as on 31 May 2015, about 35 per cent of total rural households (59 million in number) in the country are yet to be electrified (Table 2). In today's context, rural electrification has five major facets (Garud, 2015):

- Setting up of rural electricity infrastructure
- Providing connectivity to households
- Adequate supply of desired quality of power
- Supply of electricity at affordable rates
- Providing clean, environmentally benign and sustainable power in efficient way

The technological, financial and institutional challenges continue to be daunting. Bihar, UP, Jharkhand, Odisha, MP and Rajasthan are lagging behind in empowering the community and generating public opinion for the challenging task. Efforts of the central government through the previous *Rajiv Gandhi Grameen Vidyutikaran Yojana* and the present *Deen Dayal Upadhyaya Grameen Vidyutikaran Yojana* (DDUGVY), *Kutir Jyoti Yojana* and different state initiatives (for example *Biju Gram Jyoti Yojana* in Odisha) indicates the political will[†]. These programmes have incorporated the technological

[†] 'Most of the feeders connecting agriculture consumers also have rural domestic and commercial consumers in the system. Absence of appropriate metering systems, and with agriculture connections mostly unmetered, makes it difficult for distribution utilities and the state regulators to ascertain actual consumption by these categories. It influences the loss calculations and resultant subsidy estimations. Moreover, in the existing supply deficit scenario, utilities resort to supply restrictions on the agricultural feeders. Such supply restrictions severely impact the supply

learnings from the experiences of Gujarat (*Jyotigram Yojana*, where domestic and agriculture feeder separation were undertaken), but lack an enabling environment for community mobilization and ownership, without which social issues of stealing of electrical conductors and coolants from transfer, theft of electricity and the unholy nexus between employees and consumers will be hard to address. Additionally, in many unelectrified villages and households where affordability and long-distance distribution of small amounts of consumption are factors, the existing policy of a centralized solution is ineffective:- financially, technologically, ecologically and socially. The Ministry of Power's authority to allow a decentralized electricity system 'where grid electricity cannot be supplied' makes the effort of the Ministry of New and Renewable Energy ineffective. A decentralized system using local primary energy resources (based on solar, biomass, hydro, etc.) has the potential to get reliable clean energy, enhancing affordability and empowering the community, while creating a local energy market and undertaking local value addition. Unfortunately, policies favour centralized solutions that obviously tilt towards the interests of big business, the powerful and rich. Lack of integration of the energy policy with other welfare measures hinders the economically weaker sections from moving up in the clean-energy spiral, without subsidy.

The government plan of 24x7 Power for All by 2019 is being implemented in a context-specific manner in partnership with different states. However, for rural electrification to be effective, the community needs to be socio-economically empowered. Immediately after independence and during the pre-liberalization period, rural communities and farmers with strong political influence—as was the case in Gujarat, Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Punjab and Haryana—could force the respective governments towards massive rural electrification. Rural communities in these states could place themselves in a virtuous cycle of electricity-enabled income generation activities (agriculture, agri-processing, small-scale industry and commerce), leading to higher per capita income; increased affordability of cleaner energy and quality-of-life enhancing gadgets that require electricity for their operation; and finally, involvement in value-added agriculture, commerce and industry. Through better governance and management of distribution utilities (both private and public), these states could reduce aggregate technical and commercial losses. Distribution companies ensured better quality electricity supply and thus, consumers were ready to pay for it. In contrast, rural consumers in Odisha, Bihar and Uttar Pradesh operated in a vicious cycle. Absence of electrification in a large number of villages and poor quality of supply in electrified villages did not facilitate electricity-enabled income generation activities and use of gadgets. Dissatisfied customers were reluctant to pay for the poor quality of electricity service. There was no community action against the few unscrupulous elements stealing the electricity infrastructure, because most of them did not taste the benefit and only visualized

and quality to the associated rural consumer base and hence the overall socioeconomic growth in the rural areas.' (World Energy Council, 2012, p 37).

the potential loss. In recent times, with the government's thrust on completing the unfinished task of the electrification of the remaining villages in a few states, the uphill task is protection (from stealing) of electricity infrastructure through social pressure. Additional challenges include: initial investment; recovery of capital and operating cost; managing supply in case of shortage of power; and enhancing the income of consumers through sustainable income generation activities and thus, boosting the rural economy.

With technological maturity and improved financial viability of renewable energy technologies in the present market condition, there are different possibilities of decentralized DC and AC micro-grids, with or without net-metering. Electricity can be generated from solar, biomass, wind and micro-hydro sources in either pure or hybrid form. Such a system, in addition to reducing transmission and distribution losses, will provide pollution-free local energy security, local value addition and local market creation, while facilitating the development of an empowered community.

Unfortunately, the compartmental approach of the Ministry of Power and the Ministry of New and Renewable Energy may result in missing a potential opportunity. For example, instead of creating large-scale centralized solar power stations, millions of decentralized power generating unit scan feed into a 'mesh grid'. The mesh grid will operate like a cobweb with numerous points of small-scale generation and consumption. It will result in grid stability and other advantages as stated above. Of course, technological challenges of hybrid system operation and smart metering will have to be addressed. An enabling environment for creating a level playing field for distributed generators is missing today. Considering the extent of positive externality that these service providers create, the government needs to protect them from the threat of subsidized tariff and other enabling provisions in a convergence mode.

5. LPG Demand and Supply and Level of Disparity

According to the Ministry of Petroleum and Natural Gas, India has 181.9 million LPG connections as of 31 March 2015. Given that there are 246.7 million households according to 2011 Census, 73.74 percent had LPG connections. There is wide disparity among states in LPG use for cooking, and between rural and urban area within the states.

All the eastern and north-eastern states (except Arunachal Pradesh and Mizoram) have very low levels of LPG penetration. Among the major states, Punjab has the distinction of having the highest number of LPG connections (139.55 per cent). The bottom five states are Jharkhand (33.1 percent), Bihar (33.7 percent), Chhattisgarh (35.7 percent), Meghalaya (35.1 percent) and Odisha (32.3 percent) (Table 12). Weak access to LPG distributors, poor road connectivity, low capacity to bear the initial cost of connection, and low cash income are some of the reasons for low LPG usage.

In 2011–12, LPG use in rural areas varied widely among states. More than a quarter of rural households in Andhra Pradesh, Tamil Nadu, Kerala, Haryana and Punjab use LPG for

cooking; 10 to 20 percent rural households in Assam, Gujarat, Maharashtra and Karnataka use LPG for cooking. In contrast, LPG for cooking in rural households is limited to less than 10 per cent of the total in other states. More than 70 per cent of urban households in Assam, Andhra Pradesh, Tamil Nadu, Kerala, Maharashtra, Rajasthan, Haryana and Punjab use LPG for cooking. With the exception of Odisha and Chhattisgarh, 50 to 70 per cent urban households use LPG for cooking in the rest of the states (Table 13).

The use of kerosene for cooking in urban households is high in Gujarat, Maharashtra, Punjab, Tamil Nadu and Karnataka. Because of the easy availability of biomass (fuelwood, chips, crop residue and dung cake) and its relatively low price (coupled with low purchasing power), its use is significant in rural and urban households of Assam, Bihar, Chhattisgarh, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Odisha, Uttar Pradesh and West Bengal.

Table 12: State-wise Number of LPG Consumers as on 31 March 2015

State/ Union Territory	LPG Consumers as on 31 March	Number of Households as per 2011 Census	Percent of Households with LPG Connections
Andhra Pradesh	1181544	1266653	93.3
Arunachal Pradesh	24424	261,614	93.4
Assam	349766	6,367,29	54.9
Bihar	638045	1894062	33.7
Chhattisgarh	200833	562285	35.7
Goa	55901	322813	173.2
Gujarat	810075	1218171	66.5
Haryana	531099	471795	112.6
Himachal Pradesh	191638	147658	129.8
Jammu & Kashmir	217453	201508	107.9
Jharkhand	204729	618160	33.1
Karnataka	1082927	1317991	82.21
Kerala	848721	771637	110
Madhya Pradesh	773432	1496759	51.7
Maharashtra	2179304	2383058	91.5
Manipur	39002	507,152	76.9
Meghalaya	18899	538,299	35.1
Mizoram	29326	221,077	132.7
Nagaland	23282	399,965	58.2
Orissa	311705	966108	32.3
Punjab	754898	540969	139.6
Rajasthan	881314	1258130	70.1
Sikkim	15755	128,131	123
Tamil Nadu	1704403	1849300	92.2
Telangana	927161	835800	110.9

Tripura	45037	842,781	53.4
Uttar Pradesh	2144788	3292426	65.1
Uttarakhand	243277	199706	121.8
West Bengal	1045428	2006729	52.1
Andaman & Nicobar	86026	93376	92.1
Chandigarh	40830	235061	173.7
Dadra & Nagar	72139	73063	98.7
Daman & Diu	68800	60381	113.9
Delhi	614648	334053	184.0
Lakshadweep	4512	10703	42.2
Puducherry	37421	301276	124.2
India	181,902,26	246,692,66	73.7

Source: Indian Petroleum and Natural Gas Statistics, 2014–15, Ministry of Petroleum and Natural Gas, Economics and Statistics Division, Government of Indi, p. 48.

Table 13: Inter-State Variation of LPG and Kerosene Used for Cooking by Households

States	Rural Household (%)		Urban Household (%)	
	LPG	Kerosene	LPG	Kerosene
A & N Islands	38.2	18.9	71.3	21.5
Andhra Pradesh	28.9	0.2	77.3	2.7
Arunachal Pradesh	31.4	0.9	84.1	1.2
Assam	17.2	0.3	71	5.7
Bihar	5.9	0.5	60.5	0.5
Chandigarh	75.2	22.9	75.6	13.6
Chhattisgarh	1.5	0.2	39.8	2.7
Dadra & Nagar Haveli	3.7	11.4	73.1	21.1
Daman & Diu	23.8	54.2	75.7	6.5
Delhi	92.2	0.0	85.6	1.7
Goa	66.2	16.4	90.3	2.6
Gujarat	13.9	3.5	62	10.5
Haryana	26.7	1.2	86.5	1.4
Himachal Pradesh	25.2	1.0	71.8	7.4
Jammu & Kashmir	26.5	2.2	78.3	3.9
Jharkhand	2.9	0.3	53.9	1.2
Karnataka	14.7	2	64	6.8
Kerala	30.8	0.1	55.4	0.6
Lakshadweep	3.7	2.6	45.3	16.3
Madhya Pradesh	6.2	0.5	65.2	3.6
Maharashtra	23.1	1	74.5	10.1
Manipur	34.6	0.2	64.7	0.8
Meghalaya	5.5	1.0	64.0	5.7
Mizoram	39.1	0.7	93.6	0.5
Nagaland	53.4	0.0	86.3	0.3
Odisha	3.9	0.2	43.5	4.8
Pondicherry	59.2	4.0	76.2	3.0
Punjab	30.5	2.7	75.4	10
Rajasthan	8.9	0.7	71.6	2
Sikkim	56.0	0.6	82.6	2.2
Tamil Nadu	37.2	2.5	70.9	8.5

Tripura	63.0	0.5	66.8	3.8
Uttar Pradesh	6.7	0.1	66.8	1
Uttarakhand	28.8	0.9	78.8	1.6
West Bengal	6.6	0.5	56.5	8.7
All-India	15.0	0.9	68.4	5.7

Source: NSSO Report No. 567 (68th Round), 'Energy Sources of Indian Households for Cooking and Lighting, 2011–12'.

Electricity and kerosene use for lighting in rural area in 2011–12 varied widely among states. Because of the unavailability of electricity and its unaffordability, about 30 per cent or more rural households in Assam, Bihar, Jharkhand, Odisha, Uttar Pradesh and West Bengal use kerosene for lighting. The situation is worse in Bihar, where about three-quarters of rural households resort to kerosene for lighting. Similarly, among all the states, Bihar (17.2 per cent) and Uttar Pradesh (10.8 per cent) have the highest proportion of urban households using kerosene for lighting (Table 14).

Table 14: Inter-State Variation of Electricity and Kerosene Used for Lighting by Households

States	**Rural Household (%)**		**Urban Household (%)**	
	Kerosene	Electricity	Kerosene	Electricity
A & N Islands	8.8	90.0	0.1	99.8
Andhra Pradesh	2.1	97.6	1.1	98.5
Arunachal Pradesh	18.3	65.7	1.5	95.6
Assam	43.3	55.3	7.9	89.7
Bihar	73.5	25.8	17.2	81.2
Chandigarh	0.0	99.1	0.4	99.6
Chhattisgarh	13.8	85	3.6	93.1
Dadra & Nagar Haveli	1.1	97.7	0.3	99.7
Daman & Diu	.0	100.0	0.0	100.0
Delhi	.0	100.0	.0	98.8
Goa	1.8	98.2	0.2	99.8
Gujarat	6.4	93.2	5.2	94
Haryana	1.5	95.1	0.1	97.9
Himachal Pradesh	1.1	98.3	0.7	90.7
Jammu & Kashmir	3.0	96.5	0.5	98.7
Jharkhand	36.8	62.1	2.6	96.4
Karnataka	4.5	95.2	1.2	98.6
Kerala	3.3	96.2	1.4	97.3
Lakshadweep	0.0	100.0	0.0	100.0
Madhya Pradesh	15.2	84.5	1.7	98
Maharashtra	9.9	88.8	0.8	98.9
Manipur	11.9	85.0	1.4	96.7
Meghalaya	15.2	84.0	1.5	97.5
Mizoram	6.3	84.3	0.7	98.3
Nagaland	.8	98.4	0.5	98.5
Odisha	32.3	67.6	3.5	96.2
Pondicherry	0.2	99.8	0.8	99.2
Punjab	1.5	97.4	0.5	98.4
Rajasthan	21.6	77.7	1.7	97.7
Sikkim	1.9	98.0	0.3	99.7
Tamil Nadu	3.1	96.9	1	98.8

Tripura	17.8	82.0	1.3	98.1
Uttar Pradesh	58.5	40.4	10.8	88.1
Uttarakhand	2.6	97.0	0.8	99.2
West Bengal	29.3	70.2	5	94.5
All-India	26.5	72.7	3.2	96.1

Source: NSSO Report No. 567 (68th Round), 'Energy Sources of Indian Households for Cooking and Lighting, 2011–12'.

Pradhan Mantri Ujjwala Yojana

Pradhan Mantri Ujjwala Yojana (PMUY), launched on 1 May 2016, is aimed at providing 50 million LPG connections in the name of women in the BPL (Below Poverty Line) category across the country. The objectives of the scheme are empowering women and reducing the serious health hazards (including death) for women and children that are associated with cooking based on fossil fuel. The scheme is being implemented using the money saved in LPG subsidy through the 'Give-it-Up' campaign. The scheme provides a financial subsidy of 1,600/LPG connection and has the provision of EMI facility for meeting the cost of stove and refill. With the completion of the three-year scheme in 2018–19, the number of non-LPG user households in the country will be halved.

The key drivers of LPG diffusion include push from the natural gas companies, multilateral and bilateral financial institutions, increased literacy, income and aspirations of the rural community, demand for clean energy from the more vocal rural and urban households who are vote banks for the political parties, and the government's development agenda.

6. Women and Inclusive Energy Use Policies and their Results

The United Nations' Sustainable Development Goal 7 calls for ensuring access to affordable, reliable, sustainable and modern energy. Sustainable Energy for All (SE4All) is planned to be met by 2030 by interlinking three global targets:

- Ensuring universal access to modern energy services
- Doubling the global rate of improvement in energy efficiency
- Doubling the share of renewable energy in the global energy mix

As recommended in the guidance note to gender equality, women's empowerment and sustainable energy, 'women can be powerful actors for change in the transition to sustainable energy and that their involvement in the design, distribution, management and consumption of sustainable energy solutions is a critical pathway for reaching the MDGs as well as the objectives of the SE4ALL initiative' (UNIDO, n.d.).

The Integrated Energy Policy (IEP) of 2005, articulated by the Planning Commission, had the broad vision 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 and convenient energy at the least cost in a technically efficient, economically viable and

environmentally sustainable manner. Under 'household energy security', the IEP specifically addressed the issue of providing electricity and clean fuel to all, particularly rural households. The policy took note of gender issues explicitly:

> …considering that women carry most of the burden of the drudgery of gathering fuel wood, agricultural wastes and animal dung and also bear the brunt of the indoor air pollution; the urgency to meet the challenge should be high, if we are to achieve universal primary education for girls, promote gender equality and empower women. The considerable effort spent on gathering the bio-mass and the cow-dung and preparing the same for use is not priced into the cost of such energy. These fuels create smoke and indoor air pollution and are inconvenient to use. They have adverse impact on the health of people, particularly women and children. Easy availability of a certain amount of clean energy, required to maintain life, should be considered as a basic necessity… (IEP, 2005, p 99.).

The IEP considered providing subsidized lifeline electricity and LPG supply to vulnerable households (30 per cent of India's total households) at 1 kWh/day and 8 LPG cylinders/year, and another 20 per cent households at 6 LPG cylinders/year. It suggested that the 'benefits in empowerment, health, environment and reduced pressure on deforestation and hence the water table and soil erosion are well worth the cost—even without considering the benefits from the likely increase in productivity of rural India' (ibid.).

To ensure energy security at the local level, the IEP recommended off-grid and decentralized power generation (biomass gasifier, etc.) with separate tariff policy and productive use of electricity; financing community sized biogas plants; improving the efficiency of domestic chullahs and lanterns and ventilation in the cooking area of the dwellings; planting village woodlots to reduce drudgery; clean energy entrepreneurship development for women; and supporting women's groups in the formation and management of energy cooperatives. Rural energy market development was also recommended.

In spite of these recommendations, 67.4 per cent of households depend on solid biomass (firewood, crop residue, cow dung cake, coal, lignite and charcoal) for cooking (Census of India, 2011). More than 31 per cent of households lack access to proper kitchens and cook inside the house, which exposes women and children to health risks. Lack of access to and affordability of adequate amounts of clean energy affect women and men differently because of the gender division of work in the family. Since women generally collect fuel for cooking, they have to go through the drudgery of collection of firewood and transportation from long distances. Additionally, they spend a significant amount of time cooking, and are exposed to harmful smoke that results in pulmonary disorders. The main

health problems related to fuelwood use include physical strains such as coughing, backache, headache, neck ache, bruises and burning eyes, as also encounters with wild animals and snakes. The scale of the problem is evident in the fact that as on 31 March 2015, there are 64.8 million households in the country who do not have LPG and mostly use firewood for cooking. There are 59.17 million rural households who do not have electricity and have to depend on kerosene for lighting. Fortunately, the electoral compulsion is forcing the planners in the country to give adequate attention for mainstreaming gender in energy planning.

Rural households have the ability to pay for smokeless chullahs, but they lack the willingness to pay. The fuel choice made by a household is governed by a mix of factors, including ease of availability; substitutability with existing fuel; usability with existing utensils and appliances; ability and willingness to pay; and extent of fit within the socio-cultural structure of the society.

Based on a study of rural energy access and inequalities from an analysis of NSS data between 1999–2000 and 2009–10, it is observed that the transition witnessed in lighting fuel usage is not replicated in the case of cooking fuels because of gender- and context-specific energy resource availability and socio-economic factors. In the case of electricity, as incomes rise, the level of energy inequality decreases in India. Whereas, for both biomass and petroleum products, energy inequality increases with an increase in income (Ramji, et al., 2012).

> This could be due to the fact that higher income households have a larger set of choices in terms of the fuel basket they can choose from whereas the lower income households depend on more or less the same kind of fuel sources given their income constraints and lack of choice among different fuel types due to availability and affordability constraints. This indicates that while we would expect households to shift to cleaner fuels as incomes increase, it is not the case, as we find that for the richest households, the Gini coefficient is the highest, indicating considerable variations in energy consumption patterns among these households. Thus, this indicates that the energy consumption patterns are governed not just by income but a range of other factors such as social and cultural differences (ibid, p 22.).

The electricity connection to a household depends on the influence, availability of electrical appliances and paying capacity (initial one-time connection cost and regular electricity charges): primarily factors of household income and affordability. In contrast, the cooking energy used is dependent on access to local natural resource endowment and women's influence in decision making at the household level and 'other factors defined by certain socio-cultural contexts that a society lives in and has evolved from' (ibid, p 26.).

The 'gender-based empowerment, the needs of women and their access to and control over energy resources are seldom considered in India's energy development planning' (Parikh and Sangeeta, 2008, p 1.). Given that traditional biomass energy constitutes 28 per cent of total energy consumption in the country, and only 2 per cent of USD 100 billion energy sector (coal, oil, gas, nuclear and renewable) investment in the 11th Plan (2007–12) was spent on its management and conversion, the missing gender concern in national energy planning is clear (ibid p 1.). Key findings and recommendations from the gender audit of the National Energy Policy in India: Programs of the Ministry of New and Renewable Energy are presented in Table 15.

Table 15: Gaps and Recommendations for Gender Sensitive Energy Policy in India

Gaps in Energy Planning	Recommendations
Reorienting monitoring and evaluation protocols to reflect gender concerns in energy programmes • In spite of the importance of biomass in energy mix of the country, the level of national investments in the management and conversion technology of traditional biomass is limited and no ministry has a mandate to ensure its sustainable supply. • Lack of technical capacity, finance, land ownership and equal say at household level are the key barriers to women's participation in renewable energy projects. • Difficulty in fixing accountability in the absence of gender-disaggregated data for energy policy intervention	• Using strategic gender indicators for ministerial programme cycles. • Clear articulation of gender goals in the preparation of energy programmes • Use of gender budgeting to assess how each ministry uses its financial resources to address women's practical and strategic energy needs

Linking women's empowerment with energy development • 12.7% to 20% of the budget outlay of the MNRE's 10th Five-Year Plan addressed women's specific energy needs. The energy programmes for women have failed to recognize the potential contribution that energy services could make to women's empowerment within a socioeconomic context, and been limited to meeting their immediate needs for cooking and lighting.	• Setting up a monitoring mechanism for creation and fund utilization for gender specific programmatic goals and activities • Creating mechanisms to incorporate best practices in MNRE programmes and planning processes. • Publishing annual report that shows the benefits of energy systems in improving women's social status, increasing their employment and their decision-making within communities and households, and the percentage of energy assets managed and owned by women.

Table 15: Gaps and Recommendations for Gender Sensitive Energy Policy in India (Contd.)

Inter-ministerial coordination • Lack of inter-ministerial coordination for household clean-energy security supply chain (Electricity, Kerosene and LPG: Ministry of Power and the Ministry of Petroleum and Natural Gas; and Biomass: MNRE, Ministry of Environment and Forests, the Ministry of Rural Development and the Ministry of Agriculture).	• Developing inter-ministerial working relationship for gender-responsive programmes. • Mandating MNRE's Gender Budgeting Cell (GBC) to collaborate and advise GBCs in other ministries for integrating energy in their gender budget programmes. • Developing capacity building programmes within each ministry on understanding and using gender budgets.

Making cooking fuel available within one kilometer of rural habitations • 'Access to fuel wood plantations within one kilometer of all habitations' as biomass fuels are likely to remain the primary fuels for process heat and cooking for years to come. • Fixing similar targets for other clean and affordable forms of cooking energy in order to reduce women's drudgery, the time they lose in gathering fuel and the health impacts of indoor air pollution.	• Establishing goal for fuel wood plantations within one kilometer of all habitations and strengthening access to LPG, kerosene and biogas. • Establishing context specific mechanism for cooperating among various ministries in operationalising above goal. • Financing and capacity building support to women's groups and community based institutions in organising fuel wood plantations at the village level. • Participation of women's groups in energy policies and programmes and their implementation.

Source: Adapted from Parikh and Sangeeta (2008).

The result of the evaluation of the implementation of RGGVY by the Planning Commission (2014) indicates a positive impact of rural electrification on women. With the availability of electricity, women could easily perform household chores in the evening, get additional income from different productive activities at home without migrating to other areas, reduce drudgery of work, improve health conditions, feel safe while venturing outside after sunset, protect themselves from wild animals, communicate well through mobile telephones, entertain, broaden their worldview, and become aware of government programmes through television.

The importance of integrating gender concerns in energy policy making finds a dominant place in the 'National Policy for Women 2016: Articulating a Vision for Empowerment of Women'. Within the context of 'Environment and Climate Change', it boldly states:

> All aspects of energy-planning and policy making must include gender dimensions and actively advance women's leadership… Women participation will be ensured in the efficient use and spreading the use of solar energy, biogas, smokeless chulas and other technological applications to have positive influence on their life styles and a long term impact on meeting sustainable development goals….Environmental friendly, renewable, non-conventional energy and green energy sources will be promoted and made affordable and accessible to rural households for their basic household activities (National Policy for Women 2016, p 16).

4. CONCLUSION

The geographical distribution of primary energy in India is not uniform. Coal is concentrated in Chhattisgarh, Jharkhand, Odisha, West Bengal, Andhra Pradesh, Madhya Pradesh and Maharashtra. Large deposits of lignite are found in Tamil Nadu, Rajasthan and Gujarat. Oil is available in Assam and Western Offshore, while gas is found in both Eastern and Western Offshores. The Himalayan states in the north and north-east have great hydro potential. Wind potential is high in Andhra Pradesh, Tamil Nadu and Karnataka, and to the west, in Gujarat. With the exception of the desert areas of Rajasthan, biomass is abundantly available all over the country. Almost all the states have huge solar energy potential.

India's primary energy demand is met by about 65 per cent commercial and 35 per cent non-commercial energy. Commercial energy is met primarily by coal (41 per cent), oil and gas (39 per cent), and the balance from nuclear, hydro and other renewable sources. Non-commercial energy is mainly from biomass (crop residue, wood, chips and dung cakes). The bulk of commercial energy is used in industry (45 per cent), transport (22 per cent) and building (14 per cent) sectors. Considering the negative environmental consequences of fossil fuel (coal, oil and gas), and large-scale exploitation of hydro potential and nuclear energy, the country has made a strategic change in the direction of solar energy centric renewable energy.

While industrial and transport energy demand is skewed towards concentrated industrial hubs and urban centres—whose spatial distribution is not uniform because of economic, political, social and 'unavoidable' geographical factors—demand from the residential sector is primarily constrained by socio-economically nourished political factors.

In its pursuit to provide clean energy, India has made tremendous progress over the years. But, the demand-supply gap for electricity, oil and gas persists. In 2014–15, the entire country had an electric power deficit of 4.7 per cent, and electric energy deficit of 3.6 per cent. Stark regional disparities in the use of electricity and LPG are visible across the country. Unfortunately, states with huge energy reserves have lower usage of clean energy. The coverage of household electrification and annual per capita electricity consumption of states in the east and northeast are at the bottom. A similar situation is observed for household LPG connections. In 2014–15, the annual per capita electricity consumption in the country was 1,010 kWh. During the same year, the corresponding values for the eastern states of Bihar, Jharkhand, West Bengal, Sikkim and Odisha were 203, 835, 647, 685 and 1,419, respectively. This is, in spite of the fact that with the exception of Sikkim and Bihar, other states have electric-energy intensive and extraction-based industries. Similarly, the annual per capita electricity consumption of all the

north-eastern states remained between 295 and 704. Other major states that have low per capita electricity consumption are Uttar Pradesh (502), Madhya Pradesh (813) and Kerala (672).

As on 30 September 2017, there were 40.46 million unelectrified households in the country. Only Uttar Pradesh and Bihar contribute to 52 per cent, and along with these, Assam, Jharkhand, Odisha, Madhya Pradesh and Rajasthan together share 90 per cent of unelectrified households in the country.

The quality of electricity supply to rural households shows a wide disparity among the states. In Gujarat, Himachal Pradesh and Punjab, electricity is available round-the-clock. In all other states, the supply varies from 9 to 19 hours, with a median value of 11.5 hours. Since rural domestic and irrigation electricity supply is often the last priority in dispatch, it is possible that the villagers might not be getting electricity service in the peak evening hours when they need most.

As on 1 October 2015, there were 191 million LPG consumers in the country, with an average of 69.9 per cent households having connections. In the east, the north-eastern states, Chhattisgarh, Madhya Pradesh, Uttar Pradesh, Gujarat and Rajasthan had fewer connections than the national average. The percentage of households with LPG connections in Jharkhand, Bihar, Odisha and Chhattisgarh was 31.5, 31.8, 32.6, and 33.5, respectively.

The role of clean energy in improving quality of life and overall human development is well articulated in the plan and policy documents of national and state governments. However, the financial, technological and institutional challenges are daunting.

For rural households to avail of reliable electricity service, the challenges of initial investment, recovery of capital and operating cost, managing supply in case of shortage of power, and enhancing the income of consumers through sustainable income generation activities need to be addressed. Financially unviable subsidized electricity service, in spite of its political expediency, cannot be a long-term solution. Transition to electricity is contingent upon household income levels. Without a comprehensive strategy for increasing household income and assuring regular income, government programmes like giving free connection will also not be of use, since they may not be in a position to pay regular electricity bills.

With technological maturity and improved financial viability of renewable energy technologies in present market conditions, there are different possibilities of decentralized DC and AC micro-grids, with or without net-metering. Electricity can come from solar, biomass, wind and micro-hydro sources in either pure or hybrid form. Such a system, in addition to reducing transmission and distribution losses, will provide pollution-free local energy security, local value addition and local market creation

while facilitating the development of an empowered community.

The government's plan of 22x7 Electric Power for All by 2019 is being implemented in a context-specific manner in partnership with different states. The effectiveness of such an initiative is contingent upon community vigilance against theft of electricity infrastructure and electric energy. Unless political will and empowered communities are in place, long-term clean energy security cannot be realized.

Women-inclusive Energy Policy in Remote Areas

In India, the upward movement on the clean energy ladder from kerosene to electricity for lighting is primarily due to accessibility and affordability. There is no specific evidence that women's concerns of reducing the drudgery of work and getting a better quality of life have been taken into account. But, the transition to cleaner cooking fuel, say from biomass to LPG, has been factored into gender and context-specific energy resource availability and socio-economic factors. Hence, to ensure a gender-sensitive energy policy, there is a need to reorient monitoring and evaluation protocols to reflect gender concerns in energy programmes, linking women's empowerment with energy development and making cooking fuel available and affordable (through sustainable livelihood security) within the proximity of the habitation.

Given the availability of matured renewable energy technology endowment in the country, rural areas are uniquely positioned at this time to have clean energy security at remote locations. The issue is the problem of the last mile. Hence, appropriate institutions must be brought in, with or without market mechanisms that can bridge the gaps in technology supply chain, social financing, and assurance of primary energy availability. For example, available solar energy operated lights and fans for utilitarian needs and income generation programmes are currently financially viable. In some instances biomass-fed smokeless cook stoves, solar cookers and biogas-fed cook stoves fail to gain ground due to a weak supply chain, lack of a workforce of skilled women and lack of social financing. Such institutional gaps need to be bridged while implementing clean energy-based sustainable livelihood security in a decentralized manner.

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