Decoding Energy Inclusiveness for India 2015

Paper presented

in

9th Biennial International Workshop in Advances in Energy Studies,

held at

Stockholm, Sweden, May 4-7 2015

by

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An abridged version of the paper is published in
the Conference Proceedings 'BIWAES 2015'

available for downloading

Decoding Energy Inclusiveness for India 2015

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Abstract

Disparity in energy consumption resulting in increasing divide between rich and poor is socially, economically and environmentally unsustainable. It is generally understood that poverty is a major threat to India's society. Access to affordable energy is a critical input for people to come out of vicious circle of poverty. Access to modern energy is essential for the provision of clean water, sanitation, lighting, heating, cooking and telecommunications services. Energy deprivation is not only an economic evil; it also causes much social malaise.

India is one of the low ranking per capita energy consuming countries in the world. This paper is an attempt to understand how much low is India's energy consumption against requirement. It is an attempt to look at India's energy inclusiveness by alternate measurement tools. Alternate concept of energy inclusiveness has been surveyed and their estimated values have been put together. This attempt gives rise to a consolidated picture which delineates the nature and dimension of problem of energy inclusiveness for our country. It is premised that once the extent and dimension of the problem of energy inclusiveness is brought out from diverse perspectives, then solutions in terms of policy, systems and architecture will be attempted.

The paper attempts to reflect on the following questions:

- What is acceptable definition of energy poverty and access to modern energy?
- What are the concepts and tools used in literature to indicate energy inclusiveness in India
- What is the scene of energy inclusiveness in India, putting together all indicators?
- Where should lie the focus of action, if energy inclusiveness in India has to improve?

The paper is structured in three sections. Section I attempts to portray energy scene in India in the current macro view and the most likely scenario to emerge in 2035. Section II provides the concept and definition of energy deprivation and accessibility. Section III provides various methods and tools that are used in literature to measure and indicate energy inclusiveness in India. Each of the tools and indicators has been quantified to build a consolidated picture of energy inclusiveness or otherwise that prevails in India.

Key words: Energy, India, per capita energy consumption, energy inclusiveness

Background

2014 marks the commencement of the United Nation's Decade of 'Sustainable Energy for All', the international effort to bring modern and sustainable energy to everyone on the planet. World over there is a drive to ensure 'modern energy for all'. (www.se4all.org) SE4ALL initiative has 3 global objectives: a) to ensure universal access to modern energy services; b) double the global rate of improvement in energy efficiency; and c) double the share of renewable energy in the global energy mix; all by 2030.

International Energy Agency (IEA) estimates that 1285 million people, equivalent to 18% of the world population and 22% of those living in developing countries, did not have access to electricity in 2012. India remains the country with the largest population without electricity access at 304 million people; with national electrification rate at 75% (urban 94% and rural 67%). (IEA, 2014)

IEA also estimates that more than 2679 million people, almost 40% of the global population, relied on the traditional use of biomass for cooking in 2012; 38 million more people than in the previous year. This deteriorating situation is primarily due to population growth outpacing improvements in the provision of clean cooking facilities. In India, 815 million people, around two-thirds of the population relies on traditional biomass. (IEA, 2014) National Sample Survey conducted by Government of India for the period July 2011 to June 2012 reports that 83.5% households in rural India and 23% in urban India use firewood and chip for cooking. (NSSO, 2014)

Energy systems in India have evolved over last six decades along with country's economic development, supporting the aspiration of 1.2 billion people, within the framework of democratic polity, globally integrated economy and environmentally sensitive regime. India pursued a reformed development agenda since 1991. Significant effort has gone into improving energy availability as support to country's development initiatives. May 2014, the time the current BJP led NDA government came to power, marks a watershed in India's development agenda, as India tries to break from the slow growth symptom of last decade (2004 – 2014), during the tenure of the previous Congress led UPA government.

A general view that emerges before an observer of India's energy scenario is that there is going to be high order of increase in demand for all kinds of energy; commercial and conventional, renewable and non renewable, fossil fuel and green fuel. The demand will be fuelled by factors like: i) changing lifestyle of 1.25 billion population, climbing energy ladder, ii) economic growth in the form of elimination of poverty and structural transformation of the economy. iii) Technological refinement in manufacturing and increasing share of services in the composition of GDP will create high energy efficiency, leading to low energy intensity in production. iv) There will be more and more compulsions for green energy with a view to reduce environmental degradation and greenhouse gas emission.

The forces operating from supply side are mostly external to India, as India remains import dependent for large part of its energy supply of all types, may it be oil, gas, coal and nuclear. Here global forces like geopolitics, upheaval in world capital market, climate negotiations and techno-commercial breakthrough in energy exploration and production come to play.

Notwithstanding India's continued effort to improve energy security, the issues that are relevant in the global realm are so imponderable that India as a country has to only adapt to it. India no doubt is an important player in the global energy market; as a producer, as a consumer and as a trading partner, both for import and export. But it has not assumed a position where from it can cast a disruptive influence or

pose a counter to other forces, on any aspect of global energy market; be it refined product, raw material, technology, equipment, service and information. World looks at India as a major consuming country, where there is high unmet need for energy and a market where purchasing power exists. However, availability from non renewable sources from indigenous sources will make a supply side difference in the long run.

Section I

Energy Scene in India

India's commercial energy basket has a mix of all the resources available including renewable energy sources. India's coal dependence is borne out from the fact that 64.7% of primary energy used is coal and 60% of the electricity generated is from coal based power plants. Other renewables such as wind, geothermal, solar, and hydroelectricity represent a 2% share of the Indian fuel mix. Nuclear holds 1.3% share, as presented in Table 1.

Table 1: Total Primary Energy Supply in India – 2012-13

Sr. No	Primary Energy Supply	Kilo Tonne Oil Equivalent	Percentage share to Total
1	Coal	415686	64.7
2	Crude Oil	226919	35.3
3	Oil Product (Net Export)	-54537	-8.5
4	Natural Gas	36120	5.6
5	Nuclear	8566	1.3
6	Hydro	9772	1.5
7	Solar, Wind & Others	2	0
8	Electricity (Import)	443	0.1
	Total	642972	100

Source: CSO, 2014

Combustible renewables and waste constitute about one fourth of Indian energy use. This share includes traditional biomass sources such as firewood and dung, which are used by more than 800 million Indian households for cooking.

Most Likely Energy Scenario for India in 2035

The projection of energy to be consumed in India by 2035 is based on the best scenario case prepared by British Petroleum in their publication 'BP Energy Outlook 2035' (BP, 2015)

Total Primary Energy Consumption

Table 2: Total Primary Energy Consumption

Fig-Million tonnes oil equivalent

	Year 1969	Year 1991	% increase in 22 years (1969 – 1991)	Year 2013	% increase in 22 years (1991 – 2013)	Year 2035	% increase in 22 years (2013 – 2035)
India	66.3	190.7	188	595	212	1355	128
World	4649.6	8163.3	76	12730	56	17455	37
China	157.8	691.6	338	2852	312	4562	60

Source: BP, 2015

India's energy consumption will take leap by 128% in next 22 years. The rate of jump is the highest ever, reflecting the peak phase of economic growth in coming 2 decades. This is in contrast to the trend experienced by world energy consumption in aggregate and by China; where there is slowdown in the projected rate of energy consumption as presented in table 2.

For world, primary energy consumption is likely to increase by 37%, between 2013 and 2035, with growth averaging 1.4% per annum. Virtually all (96%) of the projected growth will happen in non-OECD countries, with energy consumption growing at 2.2% per annum. Energy consumption of OECD countries, by contrast, will grow at just 0.1% per annum over the whole period and would be falling from 2030.

The projected growth rate of global energy consumption is significantly slower than the recent trend (2.4% per annum for 2000 – 2013). This slowdown is most marked in non-OECD Asia, where growth has averaged 7% per annum since 2000 and is projected to slow to 2.5% per annum between 2013 and 2035.

The slow rate of growth in the next 2 decades reflects the end of the phase of rapid growth in energy demand in developing Asia, centered on China, driven by industrialization and electrification. Slower economic growth and an accelerated reduction in energy intensity (as economic growth becomes less dependent on heavy industry) play roughly equal parts in explaining the slowing of energy growth.

India's demand growth of 128% outpaces each of the BRIC countries as Russia (+14%), China (+60%) and Brazil (+72%) all expand more slowly. India's growth is almost double the non-OECD aggregate of 63%.

Table 3: Top Five Primary Energy Consuming Countries in World in 2013

Sr. No	Country	Primary Energy Consumption (Million Tonne Oil Equivalent)	Growth over previous year (%)	Share to World (%)
1	China	2852.4	4.7	22.4
2	USA	2265.8	2.9	17.8
3	Russia	699.0	0.2	5.5
4	India	595.0	4.1	4.7
5	Japan	474.0	-0.6	3.7

Source: BP (2014)

In 2013, India was the 4th largest energy consuming country in the world, consuming 4.7% of total world consumption of energy, following China (22%), US (17.8%) and Russia (5.5.%). India's share of global demand rises to 8% in 2035, accounting for the second largest share of the BRIC countries with China at 26%, Russia 5%, and Brazil 3%.

Energy Security Situation in 2035

During the projected period, that is 2013 to 2035, while energy consumption would jump by 128%, energy production is slated to jump by 117%. India's energy production as a share of consumption declines from 59% today to 56% by 2035; imports rise by 143%. This reflects, on overall basis, India's import dependence to rise, highlighting the issue of energy security.

Currently India imports Coal, Crude Oil and Natural Gas and exports Coal and refined petroleum products. Coal import is necessitated due to inadequate indigenous production and also to get better quality of coal required by steel plants. During 2012-13, out of 704 million ton of coal consumed in the country, 138 million ton, i.e., 20% was imported. The import component is increasing; from the level of 39 million ton in 2005-06 to 138 million in 2012-13. During the same period, quantum of coal exported increased from 2 million ton to 2.8 million ton. (CSO, 2014)

During 2012-13, out of 219 million ton crude oil processed by Indian refineries, 184 million ton, i.e., 84% was imported. However, India has built good refining capacity which enables it to export 63 million ton of refined petroleum products, increasing from the level of 23 million ton in 2005-06.

During 2012-13, India imported 13 million ton LNG, constituting 38% of gas consumed in the country.

It is projected that during 2013 to 2035, quantity of oil import will rise by 161%, coal import by 96% and gas by 270%.

Composition of Energy Basket in India 2035

Best estimate of energy types to be used in India 2035 points out that demand for all fossil fuels would grow. Gas use is estimated to increase by 145%, followed by oil at 117% and coal at 112%, while renewable will increase by 564%, nuclear by 363% and hydro electricity by 98%.

Table 4: Change in Energy Type Mix in India 2035

	Unit	Oil	Natural Gas	Coal	Nuclear Energy	Hydro Electric	Rene wable	Total
2013 Base Year	MTOE	175.2	46.3	324.3	7.5	29.8	11.7	595.0
Composition in 2013	%	29.5	7.8	54.5	1.3	5.0	2.0	100.0
2035 Last Year of Projection Period	MTOE	380.3	113.4	687.5	34.9	59.1	77.9	1353.1
Composition in 2035	%	28.1	8.4	50.8	2.6	4.4	5.8	100.0

Source: BP (2015)

The proportion of energy basket in 2035 (from the base level of 2013) does not show much of alteration, except that renewable types of energy will improve its position from 2% now to 5.8%; followed by improvement of nuclear energy from 1.3% to 2.6%. Share of fossil fuel will climb down from the current level of 92% to 87%.

Key Uncertainties

The most likely scenario presented above is based on some assumptions, which bring uncertainty to the projections. This projection may be taken as the base case for discussion and policy action. Some obvious and inherent uncertainties are presented below:

It is assumed that during the projection period, GDP of India will grow at 6% in the first decade and will slow down to 5% in the following decade. By 2035, India will be the 3rd largest economy in the world, China being at the top. This appears to be a fair assumption, but there is no certainty that India's GDP will follow the assumed trajectory. Going by the positive symptoms of macroeconomic stabilization, visible during last 8 months of the new Government at the Centre and positivism outcome of RBI's Consumer Confidence Survey, December 2014, GDP growth may shift to higher trajectory in near to medium term. (RBI, 2014) In that case, energy consumption will certainly increase, as there is evidence to suggest that 'growth rate of GDP leads to more demand for natural gas and electricity consumption'. (Mallick)

India's Planning Commission (now renamed as 'NITI Aayog') observes: "The elasticity for per capita primary commercial energy supply with respect to per capita GDP (i.e. percent increase in per capita energy consumption for one percent increase in per capita GDP) estimated from the time series data of India over 1990-91 to 2003-04 comes to 0.82 which is significantly lower than 1.08 estimated for the period since 1980-81. Similarly the elasticity for per capita electricity generation is only 1.06 for the period from 1990-91 to 2003-04 compared to 1.30 for the period since 1980-81. However, the energy elasticity

of GDP growth in India may not fall as much in the future as rising income levels will foster life style changes that are more energy intense." (Planning Commission, 2014)

Another uncertainly lies with the behavior of prices of crude oil and natural gas in international market. Macroeconomic indicators do respond to such developments, particularly so in country like India, which is highly integrated to world economy. International Energy Outlook 2014 has made projection for India's energy consumption under high oil price scenario and low oil price scenario. (EIA, 2014)

Energy Demand & Supply Sources

Energy consumption in its aggregate value is known to be a function of: a) economic activity, particularly manufacturing activity, b) state of technology, and c) population growth. There are studies to show that increase in energy consumption leads to increase in GDP. However, India specific study for the recent period has to be seen to arrive at any definitive conclusion. From the point of view of energy inclusiveness in the country, it is significant to analyze the following issues:

- How much of which energy India consumes and what is the trend?
- Where from these are sourced, from within the country or outside the country?
- Which sectors these energies is used in and for what purpose?

Table 5 presents the types and quantity of primary conventional energy used in India for over 40 years.

Table 5. Trend in Consumption of Conventional Energy in India

Figure in Peta Joules

Year	Coal and Lignite	%Share to Total	Crude Petroleum	%Share to Total	Natural Gas	%Share to Total	Electricity*	%Share to Total	Total
1970-71	1491	61	770	32	25	1	157	6	2443
1975-76	1929	62	933	30	43	1	217	7	3122
1980-81	2288	61	1082	29	59	2	296	8	3725
1985-86	3051	56	1797	33	191	3	443	8	5482
1990-91	3800	53	2168	30	492	7	685	10	7145
1995-96	5059	55	2459	27	697	8	997	11	9212
2000-01	5396	45	4331	36	1073	9	1140	10	11940
2005-06	7009	46	5448	36	1207	8	1483	10	15147
2010-11	9207	42	8248	38	1974	9	2464	11	21893
2011-12	9325	42	8547	38	1790	8	2721	12	22383
2012-13	9909	41	9178	38	1532	6	3283	14	23902
2013-14	9939	41	9316	39	1334	6	3482	14	24071

*Includes thermal, hydro and nuclear electricity from utilities
Source: CSO (2013,2014 & 2015)

Table 6 presents data pertaining to total primary energy consumption of India in comparison to BRIC counties and world, current as well as future projection in terms of average annual percentage change during 2010-2040 (Reference Case).

Table 6. Total Primary Energy Consumption: Current and Projection in BRIC Countries (including World)

Fig – Quadrillion BTU

	2009	2010	Change 2010 over 2010	2015	2020	2025	2030	2035	2040	Average Annual change 2010-2040
	Actual	Actual	%	Projection						%

India	23.1	24.2	5.63	27.5	32.1	37.2	42.6	48.7	55.0	2.7
China	93.1	101.2	8.70	132.2	159.0	180.9	198.9	213.3	219.9	2.6
Russia	27.0	29.6	9.63	31.0	33.3	35.7	38.0	39.9	40.5	1.0
Brazil	12.7	13.7	7.87	14.9	16.5	17.8	19.9	22.3	25.4	2.1
World	498.4	523.9	5.11	572.0	629.8	680.4	729.2	777.1	819.6	1.5

Source: EIA (2013)

Data reveals that India's current level of growth in energy consumption is the least (5.63%) among BRIC countries; however its growth projection for the future is the highest (2.7%).

From the perspective of this paper, that is inclusiveness in energy use, we observe the following:

- 13.2% of total energy used in 2011-12 in India is for residential purpose. Energy use in the residential sector is defined as the energy consumed by households, excluding transportation uses. In the residential sector, energy is used for equipment and appliances that provide heating, cooling, lighting, water heating, and other household demands.

- 2.1% of total energy used in India in 2011-12 is for commercial and public service. 4.4% is used for agriculture and forestry. Comparable number for previous years is not available.

  The commercial sector brings together categories of energy use associated with profit-seeking and nonprofit enterprises that provide services, including those for public administration. The sector focuses on energy consumed by heating and cooling systems, lights, water heaters, and other equipment in the buildings where businesses, institutions, and other organizations are located. Examples of commercial sector buildings include schools, retail stores, restaurants, hotels, hospitals, office buildings, and leisure and recreational facilities.

  To present a comparable picture, United States' average GDP per capita in 2010 was $42,130 (in real 2005 dollar per person), and annual residential energy use per capita was estimated at 36.8 million Btu. In contrast, India's per capita income in 2010 was $2,989 (about 7.1 percent of the US level), and its residential energy use per capita was 1.4 million Btu (about 4 percent of the US level.)

- Only Oil products and electricity are two energy carriers which have got use in transport, residential and commercial activities. These are the activities which promotes energy inclusiveness. 19.9% of Oil products and 18.8% of electricity have been used for residential purpose in 2011-12 in India.

- Two energy carriers which touches everyday life of all people, namely petroleum products and electricity are import intensive for their raw material (Petroleum products for crude oil and electricity for gas). During 2012-13, India imported 84% of crude oil and 35% of gas used in the country. Therefore energy inclusiveness needs country's strength on external front, particularly, on foreign exchange balance.

- A micro assessment made by India's Central Electricity Authority brings out that during 2013-14, power availability increased by 5.6% over the previous year, still there was deficit of 4.2%. (Against requirement of 1,002,257 MU, availability was 959,829 MU, leaving shortage of 42,428 MU). (CEA, 2014)

From the above statistical premises and from author's experience of working in the Oil Industry for last 28 years, we would say; India is not only an energy deficit country, it is an energy starved country. The energy market in the country is supply driven. Given the price, energy is consumed, if available; otherwise, life in India goes on without commercial energy; on its native way.

One piece of statistics to substantiate the above point may be quoted here. (Arun, 2014) “Power lines have been drawn to 5.9 lakh villages. While 1,15,000 MW of generation capacity has been added since 2004, up to 50,000 MW of capacity lies idle, for want of fuel, creating bad loans for banks and depriving villages of power.”

Going forward, economic growth and population growth will be the two key factors which will lead to growth in energy consumption. Urban areas, which accounted for 31% of India’s population in 2010, would account for 46% of the population in 2040. In emerging economies, such as India, there are significant differences in energy consumption patterns between rural and urban areas. Biomass is widely used for cooking in rural areas. As people’s quality of life improves, they switch to more efficient and modern fuels.

India will have the world’s most rapid rate of economic growth at 6.1% per year. Further, India’s population will grow faster than China’s, and India will become the world’s most populous country by 2021. Despite faster growth in GDP and population, growth in India’s residential energy consumption resembles that of China, increasing by 3.7% per year, from 1.7 quadrillion Btu in 2010 to 5.0 quadrillion Btu in 2040. (EIA, 2013)

The government of India has been engaged in various energy efficiency programs for household appliances and buildings, particularly since 2002, with the establishment of the Bureau of Energy Efficiency. Further improvements in the energy efficiency of residential buildings and equipment will affect India’s residential sector energy consumption, although again, similarly to China, residential sector energy consumption will increase as a result of improving standards of living and rising urbanization.

From 2010 to 2040, India’s residential sector fuel mix will change from mainly liquids to electricity, most of which is used for appliances. In 2008, lighting and refrigeration accounted for nearly 50%, and space cooling (fans and air conditioners) accounted for 24% of total residential electricity consumption. As incomes increase and more people have access to electricity, the ownership of electricity-using appliances will also increase. Residential electricity demand in India, which accounted for 35% of the country’s total residential energy consumption in 2010, will increase to 76% in 2040. Electricity use will grow more rapidly than total residential energy consumption, averaging 6.4% per year as compared with total residential energy consumption growth of 3.7% per year.

In years to come, with strong economic growth fueling rising standards of living and growing demand for services, non-OECD Asian countries (India and China are in that group) will have the world’s fastest growth in commercial energy consumption from 2010 to 2040, at 3.9% per year. Non-OECD Asia accounted for 14% of the world’s commercial sector energy consumption in 2010, but its share will grow to 18% in 2020 and 27% in 2040. China’s commercial sector consumed about 2.5 quadrillion Btu in 2010, which was almost twice the level of any other country in the non-OECD. In India, which has the world’s highest economic growth rate, commercial sector energy consumption is likely to grow at an average rate of 5.4 percent per year, which is also the world’s highest.

In both China and India, the commercial sector share of total energy consumption remains between 2% and 6% throughout the 2010-2040 period. India’s commercial sector is fueled mostly by electricity and coal, with the electricity share growing from about 59% in 2010 to 80% in 2040.

Section II

Energy Poverty & Modern Energy Access: Definition

Energy poverty is lack of access to modern energy services. These services are defined as household access to electricity and clean cooking facilities (e.g. fuels and stoves that do not cause air pollution in houses).

Two definitions and concepts of modern energy access is presented here for their robustness and computability.

UN Secretary General's Advisory Group on Energy and Climate (AGECC) defines energy access as access "to a basic minimum threshold of modern energy services for both consumption and productive uses. Access to these modern energy services must be reliable and affordable, sustainable and where feasible, from low-GHG-emitting energy sources"

International Energy Agency (IEA) defines modern energy access as "a household having reliable and affordable access to clean cooking facilities, a first connection to electricity and then an increasing level of electricity consumption over time". By defining access to modern energy services at the household level, it is recognized that some other categories are excluded, such as electricity access to businesses and public buildings that are crucial to economic and social development, i.e. schools and hospitals. This definition and measurement captures the sense of energy inclusiveness very closely.

Access to electricity involves more than a first supply connection to the household. The IEA definition of access also involves consumption of a specified minimum level of electricity; the amount varies based on whether the household is in rural or in urban area. The initial threshold level of electricity consumption for rural households is assumed to be 250 kilowatt-hours (kWh) per year and for urban households it is 500 kWh per year. The higher consumption assumed in urban areas reflects specific urban consumption patterns. Both are calculated based on an assumption of five people per household. In rural areas, this level of consumption could, for example, provide for the use of a floor fan, a mobile telephone and two compact fluorescent light bulbs for about five hours per day. In urban areas, consumption might also include an efficient refrigerator, a second mobile telephone per household and another appliance, such as a small television or a computer.

IEA definition of energy access also includes provision of cooking facilities which can be used without harm to the health of those in the household and which are more environmentally sustainable and energy efficient than the average biomass cook stove currently used in developing countries. This definition refers primarily to biogas systems, liquefied petroleum gas (LPG) stoves and advanced biomass cook stoves that have considerably lower emissions and higher efficiencies than traditional three-stone fires for cooking.

Section III

The following five methods, tools and indicators have been used to assess the status, trend and progress of energy inclusiveness in India.

A. Per capita energy consumption – time series data
B. Sustainable Energy for all Initiative – multi country data
C. Energy 'Development', 'Efficiency' and 'Sustainability' Indices - multi country and reference period data
D. Empowerment Line – normative and estimated value of people in energy excluded category
E. Access to Clean Cooking Fuel – Industry sourced micro data

Section III. A

Trend of per capita energy consumption has been estimated by National Statistical Organization, under the Ministry of Statistics and Program Implementation, Government of India. Per-capita energy consumption is a measure of energy inclusiveness under assumption that there is equity and parity in the availability and accessibility of energy to all people across the country.

Table 7 presents trend of per-capita energy consumption and energy intensity in India over a period of last 40 years.

Table 7. Per-capita Energy Consumption and Energy intensity in India

Year	Energy Consumption in billion kwh	Midyear population in thousand no.	GDP (Rs crores) (1999-2000 prices)	Per capita Energy Consumption (kwh)	Energy Intensity (kwh per Rupee)
1970-71	663.99	551311	517148	1204.39	0.1284
1975-76	840.53	617248	596428	1361.74	0.1409
1980-81	1012.58	688320	695361	1471.09	0.1456
1985-86	1477.50	766135	894041	1928.51	0.1653
1990-91	1902.75	852297	1193650	2232.50	0.1594
1995-96	2436.77	939540	1529453	2593.58	0.1593
2000-01	3154.28	1034931	2030710	3047.81	0.1553
2005-06	3909.37	1117734	2844942	3497.59	0.1374
2006-07	4226.78	1134023	3120029	3727.24	0.1355
2007-08	5108.99	1147677	3402716	4451.59	0.1501
2008-09 **	5628.88	1161495	4154973	4846.24	0.1355
2009-10	6202.51	1175480	4464081	5276.58	0.1389
2010-11	6843.24	1182105	4877842	5789.03	0.1403
2011-12	7558.47	1218076	5202514	6205.25	0.1453
2012-13 (P)	8355.13	1238052	5503476	6748.61	0.1518

** from 2008-09 GDP estimates are with 2004-05 base year.
Source: CSO (2013 & 2014)

An average Indian consumed 1204.39 kwh of energy in 1970-71. 42 years after that, in 2012-13, he is consuming 6748.61 kwh of energy; 5.6 times the level of 1970-71, a cumulative annual growth of 4.2 percent.

a) It is a reflection of higher level of energy consumption per person on average.
b) It is caused by the fact that total energy consumption in the country on CAGR basis has grown at a higher rate, 6.3 percent than the growth of population, which is 1.86 percent on CAGR basis.

To present a comparable scene, US energy use per capita was fairly constant from 1990 to 2007, but began to fall after 2007. Energy use per capita is projected to continue to decline as a result of improvements in energy efficiency and change in the ways energy is used in the US economy. Total US population is projected to increase by 21% from 2012 to 2040, but energy use will grow by only 12%, with energy use per capita will be declining by 8% from 2012 to 2040.

Table 7 also provides trend of energy intensity in our country. Energy intensity trend marks three watersheds during last 40 years: 1990-91, 2008-09 and 2011-12. Beginning 1990-91 till 2008-09, energy intensity was on a declining path. In an aggregate sense for India, it shows combined effect of a number of factors. a) GDP increased at a higher rate than the rate of increase of total energy consumption. b)

More of GDP was coming from non energy intensive sectors like service and IT sectors, c) energy availability was not that much as required.

Energy intensity indicates amount of energy consumed for producing one unit of Gross Domestic Product. Energy intensity per Rupee of GDP as shown in table 7 though declined by 0.34 percent CAGR over 40 years; in 2011-12 it stands at the level of 1980-81. In 2011-12, it has declined by 1.8% over 2010-11.

To present a comparable scene from US, from 1992 to 2012, energy use per dollar of GDP declined on average by 1.9 percent per year, in large part because of shifts within the economy from manufactured goods to the service sectors, which use relatively less energy per dollar of GDP. Going forward, as projected by US Energy Information Administration, energy use per 2005 dollar of GDP will decline by 43 percent from 2012 to 2040, as the result of continued shift from manufacturing to services (and within manufacturing, to less energy intensive manufacturing industries), rising energy prices and the adoption of policies that promote energy efficiency.

Looking at the values presented in table 7 with respect to the two indicators, namely per capita energy use and energy intensity, we conclude that there is no conclusive evidence coming from the aggregate data that energy inclusiveness has shown any substantial difference during the period 1970-71 to 2012-13. However increase of 4.2 per cent per annum in per capita energy consumption on CAGR basis during 40 years is substantial. This would have positively contributed to promoting inclusiveness in energy consumption on condition that accessibility to energy source is available equitably over socio economic and regional varieties.

Section III. B

IEA made a study to identify energy deprivation in all countries which gives us status of India vis-à-vis other countries of Asian Region and countries elsewhere in the world at a comparable state of development. Table 8 presents number and percentage of people who are deprived of access to modern form of energy in 2010, 2011 and projection for 2030.

Table 8. People without access to modern energy services

	Without access to electricity					Traditional use of biomass for cooking				
	2010		2011		2030	2010		2011		2030
	Population	Share of Population	Population	Share of Population	Population	Population	Share of Population	Population	Share of Population	Population
	Million	%	Million	%	Million	Million	%	Million	%	Million
Developing countries	1265	24%	1257	23%	969	2588	49%	2642	49%	2524
Africa	590	57%	600	57%	645	698	68%	696	67%	881
Sub-Saharan Africa			599	68%	645			695	79%	879
Nigeria	79	50%	84	52%		117	74%	122	75%	
South Africa			8	15%				6	13%	
Developing Asia	628	18%	615	17%	324	1814	51%	1869	51%	1582
India *	293	25%	306	25%	147	772	66%	818	66%	730
Pakistan	56	33%	55	31%		111	64%	112	63%	
Indonesia			66	27%				103	42%	
China	4	0%	3	0%	0	387	29%	446	33%	241
Latin America	29	6%	24	5%	0	65	14%	68	15%	53
Brazil			1	1%				12	6%	
Middle East	18	9%	19	9%	0	10	5%	9	4%	8
World	1267	19%	1258	18%		2588	38%	2642	38%	

*Indian data are pre-2011 census

In terms of energy deprivation, on both accounts as captured in the table above, India is at lower position than countries like China, South Africa, Brazil and Latin America. As per projection, 147 million people will remain without access to electricity and 730 million people will continue to use biomass for cooking in 2030.

Section III. C

Energy Development Index

International Energy Agency (IEA) has devised Energy Development Index (EDI) in order to better understand the role that energy plays in human development. EDI is a composite measure of a country's progress in transiting to modern fuels and modern energy services. EDI is a multi-dimensional indicator framed by IEA that tracks energy development country-by-country, distinguishing between developments at the household level and at the community level. In the former, it focuses on two key dimensions: access to electricity and access to clean cooking facilities. When looking at community level access, it considers modern energy use for public services (e.g. schools, hospitals and clinics, water and sanitation, street lighting) and energy for productive use, which deals with modern energy use as part of economic activity (e.g. agriculture and manufacturing).

IEA has been tracking the EDI since 2004. However, every year, they are refining their methodology and give detailed output for country's policy makers to make an assessment whether broad energy development is taking place.

We present in table 9 final ranking and EDI values of last 2 years for India and for some other comparable developing countries.

Table 9: EDI ranking and Index

Country	EDI Rank		EDI Index	
	2010	2011	2010	2011
India	41	34	0.30	0.294
Sri Lanka	42	39	0.29	0.258
Indonesia	37	33	0.34	0.297
China	26	19	0.49	0.547
South Africa	14	11	0.65	0.681
Brazil	11	14	0.68	0.590

India has improved its ranking from 2010 to 2011. But in terms of EDI index, it is lower than other developing and neighborhood countries like Sri Lanka, Indonesia, China, South Africa and Brazil.

Energy Trilemma Index

The Energy Sustainability Index ranks 129 countries in terms of their likely ability to provide sustainable energy policies through the 3 dimensions of the energy trilemma:

- Energy security: the effective management of primary energy supply from domestic and external sources, the reliability of energy infrastructure, and the ability of participating energy companies to meet current and future demand.
- Energy equity: the accessibility and affordability of energy supply across the population.
- Environmental sustainability: the achievement of supply and demand-side energy efficiencies and the development of energy supply from renewable and other low-carbon sources.

The Index rank measures overall performance of 129 countries and the balance score highlights how well a country manages the trade-offs between the three competing dimensions: energy security, energy equity, and environmental sustainability. The best score 'A' is given for a very high performance. Table 10 presents India's status for last 3 years.

Table 10: India's Energy Trilemma Index Ranking and Balance Score

	2012	2013	2014	Score
Energy Equity	110	110	105	D
Energy Security	86	76	76	C
Energy Environmental Sustainability	123	121	123	D

Source: WEC (2015)

Relevant from the point of view of this study is 'energy equity' parameter, which is low for India; but has improved in 2014. While India's ranking in 2014 is 105, ranking for Indonesia is 64, China 82, Sri lanka 83, South Africa 85 and Brazil 86.

Section III. D

McKinsey Global Institute (MGI, 2014) has devised 'empowerment line', which is metric of 8 basic needs like: food, energy, housing, drinking water, sanitation, health care, education and social security. Empowerment line is the level of private household consumption needed to achieve minimum acceptable standard of living above official poverty line living condition. MGI has estimated that a person in Indian context at 2011-12 price level needs Rs 1336 per month to spend for decent life, (Rs 6680 for a family of five) assuming that infrastructure and access points are available at efficient cost. The energy component of that has been estimated to be Rs 128 per month per person (Rs 640 for a family of five). The gap between empowerment line and poverty line is shown in table 11:

Table 11: Expenditure per month per person for Empowered Line and Poverty Line

Fig - Rupees at 2011-12 price level

	Total	Energy component
Official Poverty Line	874	107
Empowered Line	1336	128
Empowerment Gap	462	21

Source: MGI, 2014

As per above level of 'empowered line', India in 2012 has 680 million people (171 million in urban and 509 million in rural), which is 56% of India's population, who had consumption level below the empower line. From energy inclusiveness point of view, 680 million people have to spend Rs 128 per month per person on energy to come to a decent living, at 2011-12 price level. This is higher from the level of minimum living as defined by official poverty line by Rs 21 per person per month.

Section III. E

Energy poverty has also been measured in terms of access to energy services. This is considered to be an important complement to consumption based measure of poverty. Number of households in the country where clean cooking fuel, that is LPG connection, is available is a measure of energy inclusiveness. On this indicator, India has made substantial progress during last 5 years. During 2010 to 2014, 62 million households were added to the base of 114 million households who already were having LPG connection in their houses (54% addition). Table 12 provides the progress in coverage of households having LPG connection in India:

Table 12: Households having access to LPG for cooking

	Unit	2001 (Census)	2011 (Census)	2015 (Projected)
No. of Households in India	Million	191.96	246.69	256.48
No. of Households having LPG connection	Million	57.85	125.39	176.50
LPG Coverage of Households	%	30.1	50.8	68.8

Source: Data provided by Industry

Households covered by LPG accessibility in the beginning of 2015 stands at 68% and have improved substantially during last 5 years.

Conclusion

This paper brings together five methods, tools and indicators to present status and trend of energy inclusiveness in India. India has come a long way on the path of bringing people into the zone of inclusiveness in the domain of energy. But as the population number is quite large, large sub set of that number still remains outside the zone of inclusiveness.

This paper is a survey of literature on the subject. It has attempted to draw a conceptual framework on the topic of energy inclusiveness and has put India specific data together from diverse sources. Further studies particularly sector specific analysis in household sector, commercial sector and transport sector will throw micro results in terms of status and progress of energy inclusiveness. Then specific policy prescriptions will emerge.

One conclusion of the study is that energy inclusiveness in India will improve if focus is provided on adequate availability of LPG and electricity across the country and is used for residential purpose.

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