ENERGY IS ABOUT QUALITY OF LIFE OF BOTTOM OF PYRAMIND PEOPLE

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ABSTRACT

Large ground has been covered in literature and in public policy debate about role of energy in sustainable development and climate change. The issues of energy supply security, energy access and affordability, improving energy efficiency and managing demand, while de-carbonizing the energy sector, have brought focus on coherent and predictable energy policy, stable regulatory and legal framework for long term investment and innovation.

Amidst plethora of objectives being advocated, this paper argues that securing energy equity stands at the front-end of national objectives, particularly for developing countries. Energy equity has been defined as having accessibility and affordability of energy supply across the population. Irrespective of the quantum of energy supply and consumption trend in a developing country, the lack of access to adequate and affordable energy contributes to and is supported by poverty. People who lack access to cleaner and affordable energy are often trapped in a reinforcing cycle of deprivation.

This paper hypothesizes that energy equity has to be the frontline objective. Other two objectives like energy security and sustainability add balancing value to that. Policy regulation and technology have to be oriented towards alleviation of energy poverty.

The paper is structured in the following parts:

1. The trend and pattern of energy consumption in the world, split into geo-political blocks, energy types and usage, linking to the growth in GDP, will be studied to examine the point that low per capita energy consuming countries are in the low rung of development.
2. Measures of energy equity; indices built by 'World Energy Council' and 'World Economic Forum' will be plotted on time scale for select developed and developing countries.
3. The paper then brings out the case of India, profiling the energy consumption pattern with focus on energy equity. The story of India, in the light of the ratification of Paris Agreement, on the eve of UNFCCC COP22 at Marrakesh, will bring out the struggle that a country has to undertake for balancing the components of sustainable development.

INTRODUCTION

Every country in the world has energy system that serves the economic structure of that country. Both the energy system and the economic structure are dynamic in their functioning and remain in state of evolution all the time. Primary factors that shape energy system in a country are its natural endowment, types of energy that are consumed by various economic agents, (namely, households, industry and transport) production, import and export, and distribution of all types of energy. Besides many other factors, two exogenous factors impact the energy system of every country; namely technological development and policy regulation. Among the latest factors that are causing disruption in the energy system in all countries are: (i) commitment to environmental protection, adoption of clean energy and mitigation of green house gas emission and (ii) switch to low energy intensive application, improving efficient use of energy.

Countries struggle to upgrade their energy systems to fully support current and future requirements of energy security and access, sustainability and economic growth. All of this takes place against a backdrop of economic power (and associated energy demand) shifting from developed to developing countries; political power shifting from the nation state to sub-national and supra-national entities; and processes of innovation broadening from large incumbent firms to agile newcomers. This is shifting the shape of the geopolitics of energy and changing the vocabulary used to describe it. While traditional issues of energy such as commodity price volatility and physical security of supply remain salient, the elements of the energy transition, including a focus on clean energy, require policy makers to look beyond static approaches.

INDICATORS OF BALANCED ENERGY SYSTEM

There are studies to show that energy consumption and GDP are interlinked, with four hypotheses about the direction of causality between energy consumption and GDP.

i. Hypothesis of neutrality holds that there is no causality (in either direction) between these two variables.
ii. Energy conservation hypothesis holds that there is evidence of unidirectional causality from GDP growth to energy consumption.
iii. Growth hypothesis suggests that energy consumption drives GDP growth.
iv. Feedback hypothesis suggests a bidirectional causal relationship between energy consumption and GDP growth. [1]

This linkage has of late has been disrupted primarily due to: (i) shift of energy type from liquid to Gas – mostly in countries in European Union, (ii) alteration in the economic structure – income shift to service sector, dominated by digital technology, (iii) countries adhering to commitment to environmental concern that decarbonizes the energy system; commitment expressed in intended nationally determined contribution (INDC) given to UNFCCC at COP 21 Paris in December 2015.

World Energy Council observes [2], 'since 1990, most countries have experienced a close relationship between energy intensity and income (measured in economic output per capita), with increasing income tending to improve energy intensity. Over that period, global gross domestic product (GDP) per capita has risen by almost two thirds, while energy intensity has improved by almost a quarter. Interestingly, the relationship changes according to income levels: the richer the country, the larger is the energy intensity improvement with increasing per capita income. In developed countries, energy intensity has improved faster than developing countries, in part because energy efficiency has had a higher policy priority, with the gradual broadening and deepening of energy efficiency regulation ensuring continued energy savings. Economic restructuring and saturation effects play a role, alongside energy efficiency, but correcting for change in economic structure with a decomposition analysis does not change the picture significantly.'

While the pressures and possibilities for change in energy architecture are at a historic height, what is less clear is the shape the transition will take. What will the new energy architecture look like? What enabling environment will create the most effective transition towards an energy architecture needed to meet tomorrow's energy requirements both globally and for different countries? How can we ensure that the new architecture goes further to underpin the sometimes competing needs of economic growth and development, environmental sustainability, and energy access and security? Therefore there is a need to monitor some relevant indicators to have a balanced approach to energy system. This paper in later part has used two such indicators:

i. 'Energy Trilemma Index' devised by World Energy Council
ii. 'Energy Architecture Performance Index' devised by World Economic Forum

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 are 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.

ENERGY CONSUMPTION & ECONOMIC STATUS OF COUNTRIES

Aggregate energy consumption data for most countries and world at large on time series basis would reflect a secular increase. The energy system responds to the economy's requirement through a chain of supply, beginning with exploration and production, refining, transportation, trading, storage, secondary distribution and final consumption. Consumption takes place in industries as fuel and feedstock, in transport system as fuel and in households for cooking, lighting and heating and cooling.

World in 2015 consumed 13147 MTOE (Million tonnes oil equivalent) energy; showing CAGR 2.5% over 50 years (from 1965 to 2015). Though consumption in the global aggregate terms is showing a consistent increase, there is lot of unevenness in the availability of energy to people living in different countries. As energy basket composition is undergoing changes in countries, so is energy availability and consumption pattern is changing amongst countries. The share of consumption by 35 OECD countries (as economic block) shifted from the level of 71% during 1960s to 42% in 2014 and 2015. USA which in 2015 consumes 17% of world total energy consumption, did consume twice the percentage (34%) in 1965. The reverse happened in countries like China and India, whose share in world energy consumption was 4% and 1% respectively (in 1965) have ascended the percentage share to 23 and 5, respectively (in 2015). That shows there has been dispersion of energy consumption amongst the countries. [3]

World Energy Council estimates that 1.2 billion people, 16% of the world's population, are still without access to electricity and 2.7 billion people, almost 40% of global population, are without having access to clean cooking facilities. Even with the policy initiatives pronounced by countries through INDC at Paris in December 2015, there will be still large number of people without access to modern energy services, as shown in Table 1. [2]

Table 1: Population without access to modern energy services (million people)

	Without access to electricity			Without access to clean cooking facilities		
	2014	2030	2040	2014	2030	2040
Africa	**634**	**619**	**489**	**793**	**823**	**708**
Sub Saharan Africa	633	619	489	792	823	708
Developing Asia	**512**	**166**	**47**	**1875**	**1458**	**1081**
China	0	0	0	453	244	175
India	244	56	0	819	675	450
Latin America	**22**	**0**	**0**	**65**	**56**	**52**
Middle East	**18**	**0**	**0**	**8**	**8**	**7**
World	**1186**	**784**	**536**	**2742**	**2345**	**1849**

Source: World Energy Outlook 2016, International Energy Agency, pp. 92

ENERGY POVERTY AND ECONOMIC POVERTY

The energy system and challenges are unique for each country. Further, the transnational nature of both energy markets and environmental sustainability issues necessitate a view that extends past the country level. It is generally known that energy poverty is one of the causes of economic poverty. This has been examined and has been validated by analyzing data of countries, clustered under regional and economic blocks, from 1990 till 2015 from World Bank source. [4] Per capita energy consumption in LDCs (Least Developed Countries, as per UN classification) is 313 kgoe (KG Oil Equivalent) in a year (average of 25 years: 1990 to 2014). This is the least among the regional and economic blocks of countries (Table 2). That is followed in ascending order by countries in South Asia at 425 kgoe (India 455 kgoe) and Sub-Saharan Africa at 675 kgoe.

Table 2: Energy Indicator: Per Capita Energy Consumption (kg of oil equivalent)

Regional / Economic Blocks of Countries (World Bank Classification)	1990	2014	Annual Average of 25 years (1990 to 2014)	Standard Deviation	CAGR (%)
<u>High Order</u>					
North America	7665	7042	7628	339	-0.34
High Income Countries	4584	4745	4896	177	0.14
OECD countries	4240	4140	4406	153	-0.1
European Union	3441	3080	3433	138	0.44
Europe & Central Asia	3757	3157	3312	158	-0.69
<u>Middle Order</u>					
Middle East & North Africa	1194	2365	1712	338	2.77
East Asia & Pacific	1015	2137	1446	374	3.02
Latin America & Carribean	1044	1337	1187	106	0.99
Middle Income Countries	977	1405	1063	178	1.46

Low Order					
Sub Saharan Africa	691	701	675	13	0.06
South Asia	333	576	425	74	2.22
Least Developed Countries (UN Classification)	295	359	313	21	0.82
India	351	637	455	87	2.41
World	1661	1929	1722	113	0.6

Source: World Bank Open Data, www.data.worldbank.org

The above levels of low per capita energy consumption stand sharp contrast to world average of 1722 kgoe, annual average of last 25 year. The highest energy consumption block (of countries) is North America at 7628 kgoe, followed by 4896 kgoe of High Income countries, 4406 kgoe of OECD countries, 3433 kgoe of European Union and 3312 kgoe of Europe & Central Asia. (Table 2)

Country block in the middle order of average annual per capita energy consumption is MENA (Middle East & North Africa) at 1712 kgoe, followed by East Asia & Pacific at 1446 kgoe, Latin America & Caribbean at 1187 kgoe and Middle Income Group at 1063 kgoe. (Table 2)

This order of per capita energy consumption by country blocks exactly coincide with indicators of economic poverty as shown in Table 3 & 4. Economic poverty is represented by two variables: (i) Percent of population below poverty line (at $ 1.90 a day @ 2011 ppp), and (ii) Percent of urban population living in slum.

The highest percentage of population living below poverty line in 2013 (expenditure of $ 1.9 a day @ 2011 ppp) is in the block of 'Low Income Countries' at 46.17%, followed by Sub-Saharan Africa at 40.99% and South Asia at 15.09%, against world level at 10.67%. (Table 3)

Table 3: Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population)

Regional / Economic Blocks of Countries (World Bank Classification)	1990	2010	2011	2012	2013
High Order					
Europe & Central Asia	1.93	2.89	2.64	2.42	2.15
Middle Order					
East Asia & Pacific	60.23	11.11	8.44	7.12	3.54
Latin America & Carribean	15.84	6.46	5.98	5.55	5.4
Middle Income Countries	42.75	16.12	13.42	12.07	9.81
Low Order					
Low Income Countries	66.86	52.07	50.05	48.07	46.17
Sub Saharan Africa	54.28	45.68	44.06	42.6	40.99

South Asia	44.58	24.58	19.85	17.51	15.09
World	34.82	15.55	13.5	12.41	10.67

Source: World Bank Open Data, www.data.worldbank.org

Same order is followed when percentage of urban population living in slum in 2014 is taken as indicator of economic poverty. Highest country block is 'Low Income Countries' at 65.21%, followed by Sub Saharan Africa at 55.28% and South Asia at 30.57%. (Table 4)

Table 4: Population living in slums (% of urban population)

Regional / Economic Blocks of Countries (World Bank Classification)	1990	2005	2007	2009	2014
Middle Order					
East Asia & Pacific	46.69	33.13	30.6	28.95	25.8
Latin America & Carribean	35.45	25.42	24.76	-	20.46
Middle Income Countries	45.93	33.69	31.97	31	27.13
Low Order					
Low Income Countries	75.37	69.76	67.13	66	65.21
Sub Saharan Africa	67.09	60.83	58.29	56.97	55.28
South Asia	56.62	39.81	37.3	34.8	30.57

Source: World Bank Open Data, www.data.worldbank.org

Per capita energy consumption (in Table 2) shows that country block in middle order and low order are showing better growth. CAGR (25 years: 1990 to 2014) of per capita energy consumption of East Asia & Pacific shows highest increase at 3.02%, followed by Middle East & North Africa block showing increase at 2.77%, Sub Saharan Africa at 2.22% and Middle Income Countries at 1.46%.

Following the improving trend in per capita consumption (CAGR for 25 years) of country blocks in middle and lower order, there has been improvement in poverty indicator of these blocks of countries over the years, as seen in Table 3 & 4.

ENERGY FOR THE BOTTOM OF THE PYRAMID PEOPLE

Energy Trilemma Index of World Energy Council

The Energy Trilemma Index ranks countries in terms of their likely ability to provide sustainable energy policies through the following three dimensions:

i. 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.
ii. Energy equity: the accessibility and affordability of energy supply across the population.
iii. 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 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. Countries with good results are awarded with the score 'B'. High performers receive the score 'AAA' while countries that do not yet perform well receive a 'DDD' score. The assessment is done for 125 countries. If these 3 factors are not balanced and the overall score is not improved, then the country runs the following risks: [5]

a. Not meeting the demand: Securing energy is critical to maintain and drive economic growth. Meeting rising demand for energy enable the expansion of all sectors of the economy including agriculture, transport, manufacturing, construction, health and social services.
b. Not delivering social benefits: Energy must be accessible and affordable at all levels of the society. The shift from primary energy to electricity is a key feature of modern society and increased energy access is strongly correlated to growth in education, life expectation and economic development.
c. Minimizing Environmental Impacts: The impact of energy production and energy use on the environment must be minimized in order to combat climate change as well as the implications of local air and water pollution.

2016 edition of Energy Trilemma Index (of World Energy Council) has ranked geographical regions and GDP groups which bring out the central proposition of this paper that countries with higher GDP are also high in energy equity scale in terms of accessibility to electricity and to clean cooking fuel. (Table 5) [6]

Table 5: Energy Equity Indicators across Geographical Regions and GDP Groups

Geographical Region	GDP Per Capita	Industrial Sector	Population with access to electricity (%)	Access to clean cooking fuel (%)	
	PPP US$	(% of total GDP)		Rural	Urban
Asia	21313	31.1	88	46	75

Europe	32390	25.4	100	75	85
Lat. Am & Caribbean	13203	31.7	92	54	85
Middle East & N. Africa	37417	46.2	97	94	95
North America	39141	27.8	100	84	95
Sub-SaharanAfrica	5628	26.2	37	16	50
GDP Group #					
Group I (> 33,500)	54608	31.9	98	88	88
Group II (14,300 – 33,500)	22818	32	97	76	87
Group III (6,000 – 14,300)	10999	31.1	89	47	83
Group IV (< 6,000)	3360	24.7	47	13	49
Global Avaerage	**22937**	**30.1**	**84**	**57**	**78**

Countries have been grouped on the basis of GDP per capita, US$ per annum

Source: World Energy Trilemma 2016, World Energy Council, pp. 91

Table 6 presents the energy equity ranking of 10 countries, selected at interval of 10 out of 125 countries, prepared by World Energy Council, in order of overall Trilemma Index 2016. The energy equity ranking of each country for 3 years has been juxtaposed with select indicators (of energy poverty) to show that counties with higher overall ranking are those having higher energy equity ranking and hihger energy access indicators.

Table 6: Alignment of Energy Equity Indicators with Energy Trilemma Rankings – Select Rank Countries

Country	Overall Energy Trilemma Rank out of 125 countries	Energy Equity Rank out of 125 countries			Score on Energy Equity	GDP Per Capita	Energy Intensity	Population with access to electricity (%)	Access to clean cooking (%)	
	2016	2014	2015	2016		PPP US$	(kgoe per $)		Urban	Rural
Denmark	1	15	13	10	A	46635	0.07	100	NA	NA
U.K.	11	12	7	8	A	41325	0.05	100	95	95
Canada	22	5	14	11	A	44310	0.13	100	95	95
Australia	31	7	5	6	A	47824	0.08	100	95	95
Columbia	41	79	81	80	B	13801	0.05	97	95	49
Mexico	52	64	72	71	B	17277	0.07	99	95	61
Philippines	61	91	90	92	C	7359	0.05	83	76	34
Iraq	74	52	54	53	B	14895	0.05	98	95	91
Sri Lanka	81	93	96	96	C	11739	0.05	85	66	15
India	91	95	93	93	C	6089	0.09	75	77	14

Source: World Energy Trilemma 2016, World Energy Council

Energy Architecture Performance Index by World Economic Forum

World Economic Forum has devised a composite index, Energy Architecture Performance Index (EAPI), as a measure of 3 key indicators of a country's energy system, which are again split into 18 sub indicators. EAPI index ranks 127 countries in descending order and gives score to the 3 key indicators on a scale of 0 – 1. [7]

3 Broad Index	What the Sub indices indicate
Economic Growth and Development	This sub-index measures the extent to which a country's energy architecture adds or detracts from economic growth
Environmental Sustainability	This sub-index measures the environmental impact of energy supply and consumption
Energy Access and Security	This sub-index measures the extent to which an energy supply is secure, accessible and diversified

Table 7 presents the energy access and security ranking of 10 countries, selected at interval of 10 out of 127 countries, prepared by World Economic Forum, in order of overall EAPI index of 2017 Index. The 'Energy Access & Security Score' of each country for 4 years has been juxtaposed with 'Economic Growth & Development Score' and overall 'EAPI Score' to show that counties with higher overall 'EAPI Score' and higher 'Economic Growth & Development Score' are those having higher 'Energy Access & Security Score'

Table 7 A: Alignment of Energy Equity Economic Development Score in Energy Architectire Performance Index (Score: 0-1)

2017 EAPI Rank	Country	2014			2015		
		EAPI Score	Economic Growth & Development Score	Energy Access & Security Score	EAPI Score	Economic Growth & Development Score	Energy Access & Security Score
1	Switzerland	0.72	0.73	0.82	0.80	0.71	0.89
11	Portugal	0.65	0.62	0.77	0.73	0.61	0.86
21	Hungary	0.64	0.53	0.78	0.71	0.57	0.83
31	Czech Republic	0.60	0.50	0.84	0.67	0.52	0.88
41	Turkey	0.57	0.53	0.73	0.63	0.54	0.81
51	Israel	0.58	0.61	0.73	0.65	0.61	0.80
61	Cuba	-	-	-	-	-	-
71	Malta	0.46	0.48	0.54	0.58	0.62	0.62
81	Nigeria	0.50	0.34	0.76	0.59	0.43	0.76
87	India	0.48	0.49	0.54	0.51	0.50	0.61

Note: EAPI – Energy Architecture Performance Index

Source: 'Global Energy Architecture Performance Index Report 2014', World Economic Forum, December 2014, 2015, 2017

Table 7 B: Alignment of Energy Equity Economic Development Score in Energy Architectire Performance Index (Score: 0-1)

2017 EAPI Rank	Country	2016			2017		
		EAPI Score	Economic Growth & Development Score	Energy Access & Security Score	EAPI Score	Economic Growth & Development Score	Energy Access & Security Score
1	Switzerland	0.79	0.72	0.88	0.80	0.74	0.88
11	Portugal	0.73	0.60	0.85	0.74	0.63	0.85
21	Hungary	0.70	0.58	0.81	0.71	0.62	0.79
31	Czech Republic	0.68	0.55	0.88	0.69	0.58	0.88
41	Turkey	0.66	0.57	0.79	0.66	0.59	0.78
51	Israel	0.63	0.56	0.81	0.65	0.60	0.84
61	Cuba	0.62	0.74	0.62	0.63	0.74	0.64
71	Malta	0.60	0.64	0.61	0.58	0.60	0.61
81	Nigeria	0.58	0.43	0.76	0.57	0.39	0.75
87	India	0.53	0.51	0.61	0.55	0.54	0.72

Note: EAPI – Energy Architecture Performance Index

Source: 'Global Energy Architecture Performance Index Report 2014', World Economic Forum, December 2016, 2017

INDIA TRANSITS TO DE-CARBONIZE AND DE-SUBSIDIZE ITS ENERGY SYSTEM

India is in the midst of a multi pronged transition on energy front. A country of 1.25 billion people is on the move with compelling aspiration for better life. There is quest for quality of life that is free from the shackles of the past. A young demography is looking for dignity and development, within democratic polity.

The process of development is constrained by two factors: a) energy and b) environment. Within these two boundaries, there are issues of: a) energy equity, b) energy security and c) environmental sustainability; the 'trilemma' monitored by World Energy Council.

India is heading towards centre stage in world energy landscape, by virtue of its growing size, complexity, diversity of energy basket, linkage with other countries by way of trade, technology transfer and destination for investment. India is poised to be a major market of solar energy, as it will play a significant role in world's commitment to reduce green house gas emission.

India will contribute to the single largest share of growth, around one-quarter, in global energy demand during 2013 to 2040, as estimated by International Energy Agency [8]. India's 1.25 billion people consume abysmally low level of energy. India's energy consumption is estimated to go up from the 775 MTOE in 2013 to 1018 MTOE in 2020 and further to 1440 MTOE in 2030.

There are 237 million people, constituting 19% (26% in rural and 4% in urban), who live without electricity [8]. Indian cities will accommodate 315 million more people by 2040. As Government is focused to improve manufacturing activity, aiming at growth of income and employment, more energy will be consumed. Share of coal is likely to be 50% of energy mix. The largest source of increase in world's coal use will come from India by 2040. Oil consumption will be at 10 million barrels per day in 2040 and that will be the highest increase, comparing other countries. India is on move to decarbonize its energy system with urgency to meet its goal of having 40% share of non-fossil fuel capacity in the power sector by 2030.

Large capital investment and innovative technology, along with measures for energy security and environmental upkeep, are required for meeting India's growing energy need. Investment of $2.8 trillion is required to ramp up energy supply up to 2040. Three-quarters of this investment will be required in power sector, which needs to almost quadruple in size. India will be the second-largest coal producer in the world by 2020, and also the world's largest coal importer, overtaking Japan, the EU and China. Indigenous oil production will be inadequate to meet the growing demand, and oil import dependence will be above 90% by 2040. [8]

Expanding energy sector is certain to exacerbate already serious challenges with climate change consequences, water stress and local air pollution. Integrated policies on land use and urbanization (the 'smart cities' initiative), pollution controls, technology development, and a relentless focus on energy efficiency can mitigate these risks.

India will strive to meet the 'Sustainable Energy for all' goal of United Nations, where it is envisaged that the following 3 goals will be achieved by 2030 on global space: [9]

a) Universal access to electricity and clean cooking fuels;

b) Doubling the share of the world's energy supplied by renewable sources from 18 to 36 percent;

c) Doubling the rate of improvement in energy efficiency.

India is striving to achieve its ambitious INDC (Intended Nationally Determined Contribution) committed to United Nations Framework Convention on Climate Change (UNFCCC). [10] The significant measurable commitments are:

To reduce the emissions intensity of its GDP by 33 to 35 percent by 2030 from 2005 level.

To achieve about 40 percent cumulative electricity installed capacity from non-fossil fuel based energy resources by 2030 with the help of transfer of technology and low cost international finance including from Green Climate Fund (GCF).

To create an additional carbon sink of 2.5 to 3 billion tones of CO2 equivalent through additional forest and tree cover by 2030.

Government of India announced in 2014 its intention to have cumulative renewable power generation capacity of 175 GW by 2022 (excluding large hydropower). Out of this, solar will be 100 GW, wind 60 GW, biomass 10 GW and small hydro projects will be 5 GW. India launched international solar alliance of 120 countries in 21st Conference of Parties (COP21) at Paris in December 2015, with commitment to contribute $27 million and headquarter in India.

CONCLUSION

Disruptive trends are emerging in energy horizon, which will create a fundamemntally new world for the energy industry, characterised by lower population growth, radical new technologies, greater environmental challenges, and shift in economic and geopolitical power. These underlying drivers will re-shape the economics of energy. World policy makers have come to realize that the core objective of energy architecture is to generate economic growth and development in an environmentally sustainable way, while providing access to energy and energy security for all.

Ecoomic growth of around 7.5% makes India the fastest growing G20 economy. The acceleration of structural reforms, the move towards rule based policy framework and low commodity prices have provided a strong growth impetus. India sets an example that it has embraced sustainable energy trajectory and assures its citizens inclusive growth and leads the world towards large scale use of renewable solar energy.

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