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Indian energy crisis – A sustainable solution

Balasubramanian P[1], Karthickumar P[2 #]

[1]*EWRE Division, Indian Institute of Technology Madras, India*

[2]*Research Scholar, Indian Institute of Crop Processing Technology, Thanjavur, India*

[#] agrikarthi@gmail.com

Abstract — **India is marching towards achieving a desirable status of a developed country with rapid strides. Ensuring uninterrupted supply of energy to support economic and commercial activities is essential for sustainable economic growth. In true sense, sustainable development should be widely spread in all three dimensions – social, economic, and environmental. For all these areas, energy is perhaps the most important aspect. The production and the consumption patterns at the local and the global scale, determine not only all the activities in society, but also some major environmental issues like pollution, green house effect, and desertification. This paper presents the scenario of power generation, consumption and forecasts power requirements up to 13th five year plan. While it also stressing on energy and its close linkages with environment, poverty and sustainability. This also describes the strategies to meet the necessary demand of power and steps taken to achieve sustainability.**

Keywords *— Developed Country, Developing Country, Sustainable Development, Energy Crisis, Power Demand.*

I. INTRODUCTION

India being the second largest populated country with home to 1.2 billion people and accounts over 17% of the world's population, it faces lot of challenges in all aspects to achieve the status of developed country. Energy is one such vital sector which should be supplied uninterrupted to support unleash economic and commercial activities for promoting sustainable economic growth. On contrary, India botched to self sustain by failing to satisfy its unquenchable thirst for energy. This is because of unprecedented gap in demand and supply of energy sector.

Energy sector is vital to sustainable development and poverty reduction efforts. It affects all aspects of development -- social, economic, and environmental -- including livelihoods, access to water, agricultural productivity, health, population levels, education, and gender-related issues. None of the Millennium Development Goals (MDGs) can be met without major improvement in the quality and quantity of energy services in developing countries. So that it is the correct time to do planning and implementing the measures to achieve the status of developed country on 2020.

II. ENERGY SCENARIO IN INDIA

The level of per capita energy consumption in India is way below that in other countries (Figure 1) dictates the level of economic development. Almost 85 percent of villages in India are considered to be electrified, around 57 percent of the rural households and 12 percent of the urban households i.e., 84 million households in the country (over 44.2% of households) did not have electricity in 2000 as per Government of India report. For the planning of power generation it is necessary to project requirement of power for next 20 years. The requirement of power can be projected on the basis of

- Past power consumption,
- Per capita consumption and
- Rate of development of economy

The power consumption on the basis of past data is very low. This is because the projection is based on the past data when the growth rate of Indian economy was very low i.e. the growth in annual GDP was less than 4%. The forecasted power requirements on the basis that India becomes a developed country and on the basis of 6% annual growth rate of GDP are respectively 3879 and 3557 b kWh by the end of 13th plan. The difference in the two predictions is due to the fact that if India wishes to become a developed country by 2022, it will have to boost the economy so that it achieves the annual growth rate of more than 6%.

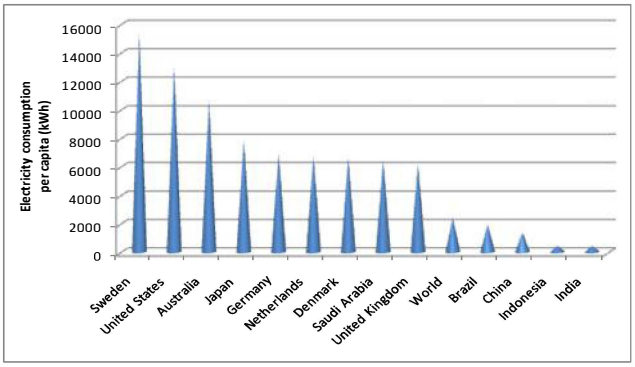

Figure 1: Global Scenario of electricity consumption per capita (Drawn based on International Energy Agency, 2005).

Sustainable energy scenarios sometimes include strong assumptions about desirable futures; because they prescribe how such futures can be achieved, they are normative. Sustainable energy scenarios are often designed to offer policy guidance on managing, for example, an orderly transition from today's energy system, which relies largely on fossil fuels, towards an energy system more compatible with sustainable development in all its dimensions (Goldemberg 1988).

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Table 1 Projections of electricity demand based on Abdul Mubeen, Energy and Environment (2004)

Plan Period On March	Per capita Power Consumption (a) *(kWh)*	Population (Projected) (b) *(Millions)*	Demand of power on the basis of			Approx. Power Capacity Required to be Installed *(MW)*
			past data *(Billion kWh)*	6 % per annum growth of GDP *(Billion kWh)*	Developed country by 2022 C = a * b *(Billion kWh)*	
1997	350	980	413	413	422	85,744
2002	950	1038	520	635	986	197,200
2007	1462	1067	635	977	1604	320,800
2012	1975	1159	750	1503	2289	457,000
2017	2487	1224	865	2312	3044	608,800
2022	3000	1293	980	3557	3879	775,800

III. Energy and Sustainable Development

For any development to be sustainable, it must not compromise the prospects of future generations. Conventional sources of production and consumption of energy are not sustainable by this definition. They are linked to significant environmental, social, and health problems not only to the present but also to the many more future generations.

1) Energy and Environment: The environmental effects of energy use occur at almost all levels from the household to the global and have consequences such as desertification, acidification, climate change, air, soil, water pollution. Although energy and environmental concerns were originally local in character – for example, problems associated with extraction, transport or lethal emissions – they have now widened to cover regional and global issues such as acid rain and the green house effect. The more efficiently we can use our energy, the less carbon dioxide will be release into the atmosphere. Energy sector and in specific electricity contributes 40 % of green house gas (GHG) emissions in India during 2007 as seen from the Figure 2.

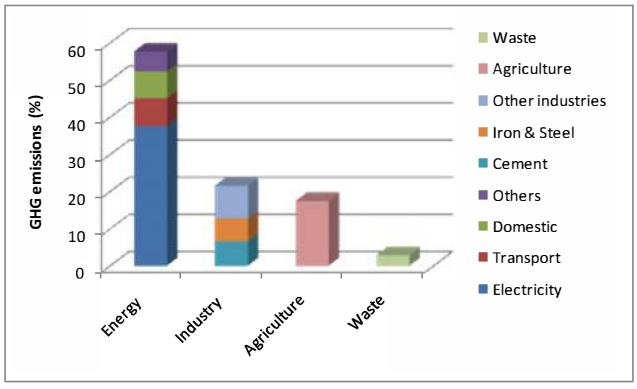

Figure 2: Sector wise Green House Gas emissions in India during 2007 (Drawn based on MoEF report, 2010).

2) Energy and Economy: The increase in concerns about environmental issues has led to revision of policies and regulations. Approaches such as pollution control tools such as polluter pays principle, using taxes to discourage to pollution, incentives in the pollution control industry will give the beneficial relation ship between environmental pollution control measures and the rate of unemployment and economic growth. Energy conservation would yield savings and would boost the economy when spent on the other goods and services. A sustainable energy future is compatible with strong economic growth. Moreover, pursuit of a sustainable energy path facilitates the realisation of sustainable socio-economic growth over the longer-term.

3) Energy and Poverty: Energy is a necessary input to improve the quality of life beyond the basic needs of house hold members, either through reducing time and manual labour required to perform task or by enabling income generating activities. Poverty is more than a lack of income. Therefore per capita income (usually measured by per capita GDP) has been widely used to indicate the degree of economic development. People often use the energy in inefficient ways due to lack of access of information, financial resources and technology. (UNDP, 2000).

If energy strategies are oriented towards the goal of sustainable development and the associated policies are implemented successfully, they will have implications for other pressing social problems. Above all, they will result in improved quality of life and Human Development Index (HDI) which is calculated from literacy rate, infant mortality rate and per capita GDP. These will help to alleviate property and creating number of jobs in energy related services such as manufacturing and installation of energy saving equipment.

Modern societies depend on reliable energy supply to sustain their productive capacity and social cohesion. Thus energy is strategically important for developing countries. According to the World Bank, countries that do not use modern forms of energy efficiently cannot realize their

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potential for creating wealth nor lift their populations out of poverty. As a developing country with huge poverty levels and aiming towards a welfare society, India has to adopt sustainable measures in energy sector.

IV. Demanded Sustainable Actions

The main issue is to design and implement energy systems that meet all the objectives of sustainable development at the same time. Accomplishing energy systems is possible by improving energy efficiency, reliance on renewable energy and cleaner utilization of fossil fuels. The challenge is therefore to formulate and implement policies that will bring about such desirable energy futures considering the demand based on populations as well as economic growth rate. The projection of Indian populations based on current trends is shown in Figure 3.

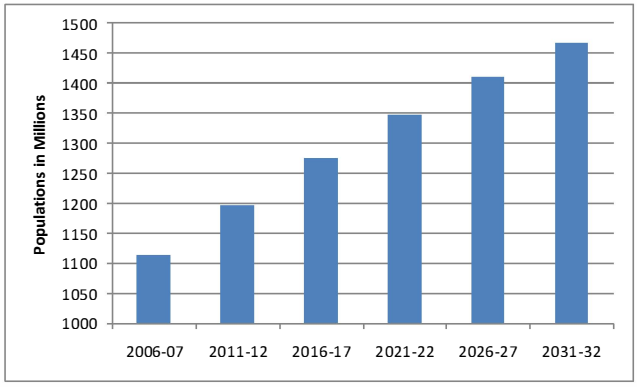

Figure 3: Indian populations projections based on current trend (Drawn based on RG&CC, 2001)

Though the primary energy supply of India is far below than the counterparts (Figure 4), substantial efforts are required in all three arenas as these three basic approaches are mandatory to achieve sustainable solution. The approaches are

- ✓ Increase supply (Scientists/Technicians/Managers)
- ✓ Reduce demand (Economists / Policy makers)
- ✓ Alternative sources (Scientists and Economists)

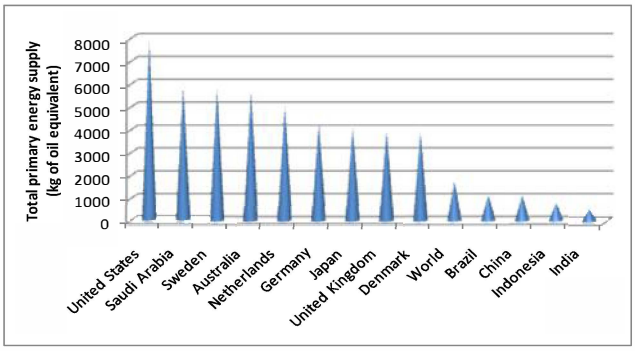

Figure 4: Global scenario of total primary energy supply for base year 2005 (Drawn based on International Energy Agency, 2005).

In other terms, energy for sustainable development refers to those energy approaches and solutions that provide the energy services which address the following major challenges:

- ➢ The secure supply of energy for economic growth and sustainable development
- ➢ The two billion people cooking on traditional fuels, of which 700 million reside in India and more than a hundred million women spending hours a day carrying fuel and water.
- ➢ The environmental challenges, including indoor air pollution, urban air pollution, acidification and climate change.

Considering all the points to ponder, the projections of total primary energy supply as well as energy requirement based on 7 and 8 % growth rate were shown in Figure 5 & 6.

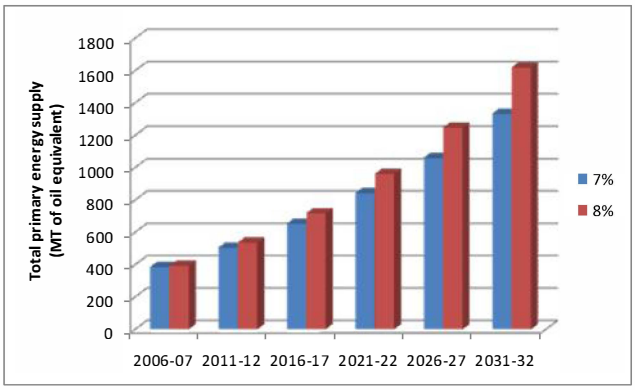

Figure 5: Projections of total primary energy supply based on 7 and 8 % growth rate (Drawn based on Integrated Energy Policy, 2005).

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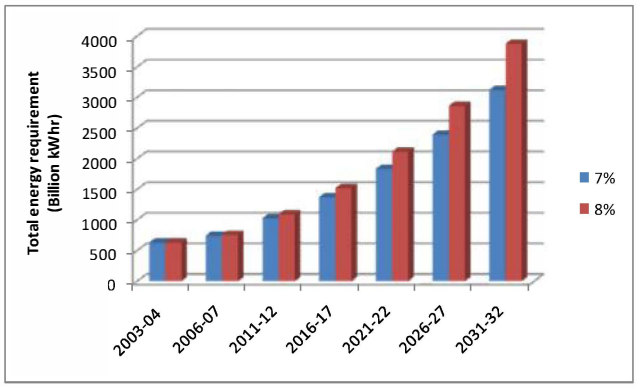

Figure 6: Total energy requirement based on Indian populations demand (Drawn based on Integrated Energy Policy, 2005).

A. Strategies to Meet the Necessary Demand of Power

The following strategies may be adopted to meet the additional power demand.

1) Energy efficiency: Energy efficiency is a critical component of our efforts to reduce load-shedding, enhance energy security, and mitigate climate change. Pune City-based Prayas Energy group studies claimed that we can save about 57,000 million units (MU) in 2013 by using energy efficient appliances like fans, air conditioners, televisions, tube lights and refrigerators. It would defer the need for generating 20,000 MW power over a period of five years or setting up one ultra-mega power plant per year (Daljit Singh and Girish Sant 2011).

2) Reduction in Transmission and Distribution (T & D) Losses: T & D losses in India are very high of about 32% against normal loss of 10% (India Energy Handbook 2011). Reduction in T & D losses by 1% could result in saving capacity of about 800 MW. Hence all the essential measures have to be taken to reduce T & D losses to the desired value.

3) Cogeneration: It is estimated that cogeneration potential in Indian industrial sector is about 8000 MW. About 50% of it is from sugar industries. Other major sources are fertilizer industries, petrochemical industries, cement industries, paper industries etc.

4) Captive Units: Captive Units in industries is used to supplement the power drawn for grind and as a standby in case of power cut. In 1996 installed Captive Units generation capacities of industries and railways was about 12,000 MW and more than half the Captive Units power was added in 1980's. With looming power shortage, similar burst is expected in near future.

5) Renovations & Modernization: Renovation & Modernization of Power plant will help the energy scenario in terms of extra picking capacity and additional availability of power.

6) Tapping Unconventional Energy Sources: Tapping unconventional energy sources like, solar, wind, tidal, geothermic and hydroelectricity in large scale. MNRE (Ministry of New and Renewable Energy) has an estimated renewable energy potential of around 85,000 MW from commercially exploitable sources, i.e., wind, 45,000 MW; small hydro, 15,000 MW and biomass/bio energy, 25,000 MW. In addition, India has the potential to generate 35 MW per square kilometre using solar photovoltaic and solar thermal energy (Varuna, Singal 2007).

7) Artificial Leaves For Sustainable Energy : Han Zhou et al., (2011) constructing artificial leaves by mimicking photosynthesis to capture solar energy, split water into hydrogen and oxygen, and convert atmospheric carbon dioxide, thus producing various forms of environmentally clean fuels, is of high significance. The gases are then sent to a fuel cell, which in turn could produce a wireless current of electricity and this device is about 10 times more efficient at carrying out photosynthesis than a natural leaf. So developing countries like India and Africa can afford this technology.

B. Measures to be Adopted:

It is to be concluded that if India is to be a developed country by 2020, it will have to put huge capital and utilize new technology like, increasing the capacity in terms nuclear & hydroelectric power and tapping unconventional energy sources. The broad strategies to encourage sustainable energy systems are straightforward. But they require wider acknowledgement of the challenges we face and stronger commitment to specific policies. The following strategies are unavoidable to achieve the desired result:

- ✓ Making markets work better
- ✓ Mobilising additional investments in sustainable energy
- ✓ Encouraging technological innovation
- ✓ Supporting technological leadership and capacity building
- ✓ Encouraging greater international cooperation

The following measure appears to be inevitable to achieve the desired result:

1) Government should take proper legal fiscal and regulatory steps to attract foreign investments in energy section.

2) Government should improve energy infrastructure, which includes establishment of new refineries. Urban gas transmission & distribution networks unified national grids and improve transplantation and facilities.

3) The power sector should upgrade the technical skills to optimum duration & investment required for

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installation of additional capacity and reduces transmission and distribution losses.

4) Government should encourage use of renewable sources of energy like solar, wind, nuclear, hydroelectricity, geothermal energy etc.
5) Government should modify the policy and price issues related to green power production.
6) Industries should encourage installing captive units for their own power consumption.
7) Government should formulate an urgent energy security policy to see that the gap between demand and supply is efficiently meant and implement it without delay.

To summarize, the plan and strategies for sustainable development focusing the current and future energy issues and for alarming the need of steps to be taken for achieving status of developed country in 2020. Renewable sources of energy, conservation, energy efficiency and subsidies are important aspects of energy sector. So concentration on scientific capacity and capability of these aspects will leads to sustainable development.

V. Conclusion

India is facing an enormous challenge in meeting its energy requirements in the recent years to sustain its economic growth rate of 9%. This problem demands the strong commitment towards a new sustainable development model that allows the growth in all the three arenas of economy, society and environment in hands by hands. It desires the paradigm shift in policy drafting and implementation that targets efficacy and affordability. Therefore the new roadmap to sustainable development requires the framework that provides holistic planning and action towards sustainability i.e towards a better tomorrow.

Acknowledgment

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