Financing and Creating Energy Infrastructure for Small Cities

Manoj Kumar Singh[*1] and Bharat Raj Singh[2]

ABSTRACT

India today needs to have around 2,OO, OOO MW of power to meet its current energy needs, but it is able to provide only about two third of it. Additional finances are difficult to come by and the infrastructure is often not available to make it reach the remote areas. Heavy roistering in city areas has been a perpetual feature in some states. Many of the dwellers of small cities have come to depend on what is called an 'inverter' and its associated battery based storage system to cope up with the frequent power outages.

Seen from another perspective these systems only lack the solar panels to become completely self contained power systems. Thus addition of solar panels to these will be only an incremental cost. By encouraging this approach several problems can be solved all the same time. First of all this additional investment will be from the users themselves. Next the power generated will be environmentally friendly and the regular power supply and the grid may need to be used sparingly. These storage based systems may become parts of Smart Grids for the future as they may be further evolved to feed power into the grid.Evaluation of the performance of these systems has been studied through simulation and the economics of the system has been investigated under various conditions for typical users. The proposed system has been compared with the early telecom systems in India that were based on land lines and could not be expanded fast enough. Later the privatized and decentralized wireless based approach provided the desirable solutions.

Keywords : *Smart Grids, Privatization, Energy, Decentralized Electricity.*

1. INTRODUCTION

Non commercial energy constitutes 84%, met mainly by sources like firewoo d, agricultural residues, charcoal and cow dung, while c ommercial energy's share is 16%, met mainly by el ectricity, oil etc.[1]

The largest single user of bio energy is the domestic sector, followed by industries . Increased shortage of wood fuels has forced many use rs to shift to substantial use of agricultural residues. Bio energy users are faced with limited options of access ible and affordable fuels. Energy resources (renewable and non renewable), energy demand (sector wise), environmental, data aggregation, data analysis (en ergy scenarios, techno economic analysis) and integra ted plans are the various modules being incorporated in the Integrated Regional Energy Plan (IREP).

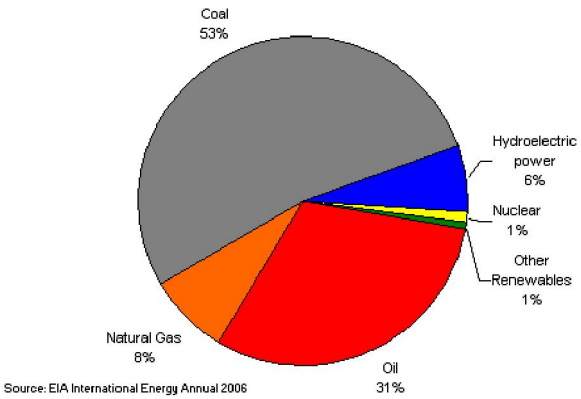

Fig. 1. Total Energy Consumption in India, by Type (2006)

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The energy scenario module along with energy demand, transformation, techno-economic and environment module are used (in integrated module) to perform an integrated energy-environment planning exercise for a region (villages / blocks/ / districts / states). Environmental database is used automatically to calculate environmental impacts of energy scenario.

Scenario analyses aids in creating a picture of the current energy situation and estimated future changes based on expected or likely plans and growth patterns. Base case or business-as-usual is based on present population growth, industrialization, agricultural energy requirement.

India today needs to have around 150.000 MW of power to meet its current energy needs, but it is able to provide only about two third of it. Additional finances are difficult to come by and the infrastructure is often not available to make it reach the remote areas. Heavy roistering in city areas has been a perpetual feature in some states. Many of the dwellers of small cities have come to depend on what is called an 'inverter' and its associated battery based storage system to cope up with the frequent power outages. Seen from another perspective, these systems only lack the solar panels to become completely self contained power systems.

Thus, addition of solar panels to these will be only an incremental cost. By encouraging this approach several problems can be solved at the same time. First of all this additional investment will be from the users themselves. Next the power generated will be environmentally friendly and the regular power supply and the grid may need to be used sparingly. These storage based systems may become part of Smart Grids of the future as they may be further evolved to feed power into the grid. Evaluation of the performance of these systems has been studied through simulation and the economics of the system has been investigated under various conditions for typical users. The proposed system has been compared with the early telecom systems in India that were based on land lines and could not be expanded fast enough. Later the privatized and decentralized wireless based approach provided the desirable solution.

2. A GLANCE AT RENEWABLE ENERGY SOURCES IN INDIA

2.1 Solar Energy

Solar power a clean renewable resource with zero emission, has got tremendous potential of energy which can be harnessed using a variety of devices. With recent developments, solar energy systems are easily available for industrial and domestic use with the added advantage of minimum maintenance. Solar energy could be made financially viable with government tax incentives and rebates.

An exclusive solar generation system with a capacity of 250 KWH units per month would cost around Rs. 5 Lacs, with present pricing and taxes. Most of the developed countries are switching over to solar energy as one of the prime renewable energy source. The current architectural designs make provision for photovoltaic cells and necessary circuitry while making building plans. [2]

2.2 Wind Energy

Wind power is one of the most efficient alternative energy sources. There has been good deal of development in wind turbine technology over the last decade with many new companies joining the fray. Wind turbines have become larger, efficiencies and availabilities have improved and wind farm concept has become popular. It could be combined with solar, especially for a total self-sustainability project.

The economics of wind energy is already strong, despite the relative immaturity of the industry. The downward trend in wind energy costs is predicted to continue. As the world market in wind turbines

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continues to boom, wind turbin e prices will continue to fall. India now ranks as a "wind superpower" having a net potential of about 45000 MW only from 13 identified states.

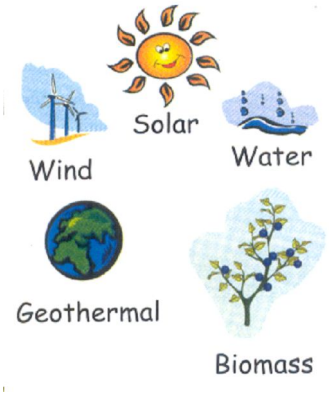

Fig. 2. Renewable Energy Sources

2.3 Hydro Electric Power

India has a huge hydro power potential, out of which around 20 % has been realized so far. New hydro projects are facing serious resistance from environmentalists. Resettlement of the displaced people with their lands become s major issue.

2.4 Biomass Energy

Can play a major role in reduc ing India's reliance on fossil fuels by making use of thermo-chemical conversion technologies. In ad dition, the increased utilization of biomass-based f uels will be instrumental in safeguarding the environment, creating new job opportunities, sustainable development and health improvements in rural areas. B iomass energy could also aid in modernizing the ag ricultural economy. A large amount of energy is expe nded in the cultivation and processing of crops like s ugarcane, food grains, vegetables and fruits which can be recovered by utilizing energy-rich residues for energy production. The integration of biomass-fue lled gasifies and coal-fired energy generation would be advantageous in terms of improved flexibility in response to fluctuations in biomass availability with l ower investment costs. Waste to energy plants offer t wo important benefits of environmentally sound waste management and disposal, as well as the gener ation of clean electric power. Waste-to-energy facilities produce clean, renewable energy through thermo chemical, biochemical and physicochemical methods. Moreover, waste-to-energy plan ts are highly efficient in harnessing the untapped so urces of energy from a variety of wastes.

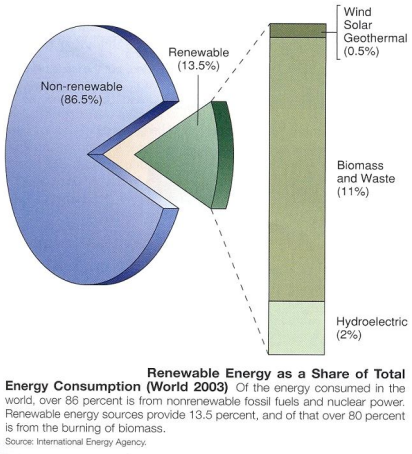

Fig. 3. Renewable Energy as a Share of Total Energy Consumption

3. A GLANCE AT A NON RENEWABLE ENERGY SOURCES IN INDIA

3.1 Oil

According to *Oil & Gas Journal (OGJ)*, India had 5.6 billion barrels of proven oil reserves as of January 2009, the second-large st amount in the Asia-Pacific region after China. In dia's crude oil reserves tend to be light and sweet, wi th specific gravity varying from 38° API in the offshore M umbai High field to 32° API at other onshore basins.India produced roughly 880 thousand bbl/d of total oil in 2008, of which approximately 650 thousa nd bbl/d was crude oil, with the rest of production resulting from other liquids and refinery gain. India has over 3,600 operating oil wells, according to *OGJ*.[3]

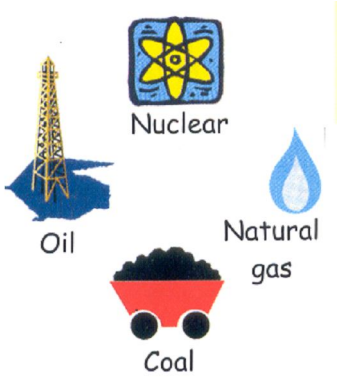

Fig. 4. Non Renewable Sources

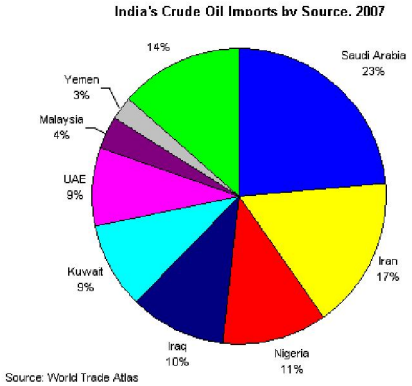

Fig. 6. India's Crude Oil Imports by Source, 2007

Although oil production in Ind ia has slightly trended upwards in recent years, it has failed to keep pace with demand and is expected by the EIA to decline slightly in 2009.

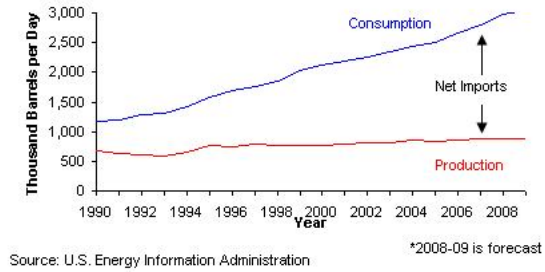

Fig. 5. India's Oil Production and Consumption 1990-2009

India's oil consumption has co ntinued to be robust in recent years. In 2007, India consumed approximately 2.8 million bbl/d, making it the fifth largest consumer of oil in the world. Demand grew to nearly 3 million bbl/d in 2008. EIA anticipates consumption growth rates flatt ening in 2009 largely due to slowing economic growth rates and the recent global financial crisis. [1,4]

3.2 Natural Gas

Although India's natural gas production has consistently increased, demand has already exceeded supply and the country has been a net importer of natural gas since 2004. India's net imports reached an estimated 353 Bcf in 2007. India imports natural gas via liquefied natural gas (LNG).

In 2007, India consumed roughl y 1.5 Tcf of natural gas, approximately 100 Bcf more than in 2006, according to EIA estimates. Natural gas demand is expected to grow considerably, largely driven by demand in the power sector. Th e power and fertilizer sectors account for nearly thr ee-quarters of natural gas consumption in India. By 2 030, EIA expects Asian demand for natural gas to more than double, and India is expected to be responsible for a sizeable part of that growth. Natural gas is expected to be an increasingly important component of energy consumption as the country pur sues energy resource diversification and overall en ergy security. [5]

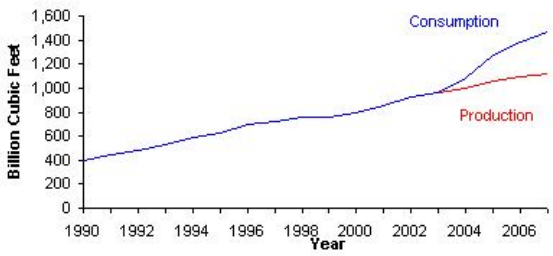

Fig. 7. India's Natural Gas Production and Consumption 1990-2007

3.3 Electricity

In 2006, India had 144 gigawat ts (GW) of installed electric capacity and generate d 703 billion kilowatt hours. Nearly all power in India is generated with conventional thermal sources, which produced over 80 percent of electricity in 2 006.[6] Hydroelectricity has been a consistent source of power in India, accounting for nearly 16 perce nt of power generated in 2006. Finally, nuclear ener gy produced roughly 2 percent of electricity during the same year, while geothermal and other renewable sources accounted for as little as 1 percent. According to Oil and Gas Journal (*OGJ)*, India had 38 trillion cubic feet (Tcf) of proven natural gas reserves as of January 2009. The EIA estimates that India p roduced approximately 1.1 Tcf of natural gas in 2007 , up only slightly from 2006 production levels. The bu lk of India's natural gas production comes from the western offshore regions, especially the Mumbai High complex. The onshore fields in Assam, Andhr a Pradesh, and Gujarat states are also significant so urces of natural gas.[1,6,7] The Bay of Bengal has also become an important source of natural gas for the country.

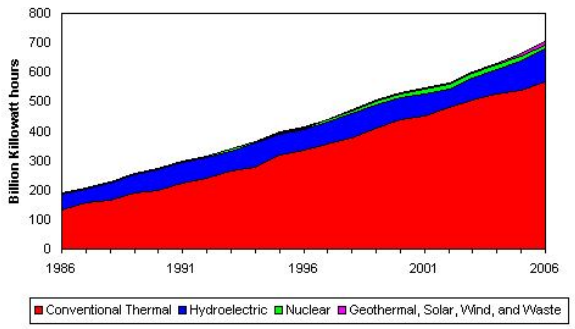

Fig. 8. Electricity Generation by Type, India 1986-2006

4. FINANCING AND CREATING INFRASTRUCTURE OF ENERGY

Most important thing is that e lectricity is a source of water . Without electricity nothing is possible. If I have a mobile, computer, TV, vehicle, internet connection etc., but power fai lure! Then nothing can be done.

So, as an honest attempt we have designed a system that is a key for solut ion.[8] of energy steps given below-

i. Planning ii. Modeling i ii. Simulating
iv. Controlling v. Tariff po licy
vi. Analysis software designin g
vii. System designing mathemat ical processes
viii. Obtain final result.

Is the following a solution fo r energy sources?

i. Animal ii. Biomass iii. Coal
iv. Oil v. Natural ga s vi. Nuclear
vii. Hydrogen viii. Renewable energy

From fig. 8 contribution of va rious energy sources in 15th century we use 50% of animal & 50% of biomass, in the mid 19th century we used 33.33% of animal, 33.33% of biomass, 33. 33% of coal, in the early 20th century we used 10% of animal, 15% of biomass, 65% of coal, & 10% of oil, late 20th century we used 5% of animal, 5% of bi omass, 15% of coal, 3% of nuclear, 17% of natural gas, & 55% of oil, in the mid 21st century we used 5% of animal, 7% of biomass, 7% coal, 7% of nuclea r, 9% of hydrogen, 35% of oil & 35% of natural ga s.

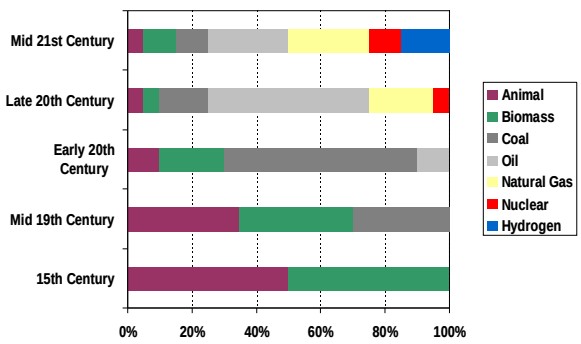

Fig. 8. Contribution of Various Energy Sources

In the 21st century we are using 2% of renewable energy, 5% of animal, 5% of biomass, 7% of coal, 7% of nuclear, 9% of hydrogen, 35% of oil, & 35% of natural gas.

For a human can not live without energy, similarly world can not stand without energy.

We need to focus on this point. Now a days we have generated only 1,50,000 MW of energy but we require 2,00,000 MW of energy, i.e. there is a lack of 50,000 MW of energy which means crisis of energy.

In 2020 we require 4, 00,000 MW energy. [9]

So, our main motive is of developing India to do something in reference with the following points:

i. Population ii. Environment
iii. Pollution iv. Infrastructure
v. Economic Growth vi. Transportation
vii. Industry viii. Resources
ix. Financial x. Public Private Partnership

The dream of A.P.J. Abdul Kalam in 2020 is to maintain a gap between rural area and town area so that every thing is possible according to the Plan, Model, Design, Simulate, Control, Implement so as to obtain a complete solution of energy.

5. CONCLUSION

Energy is the measure of the development of any nation. Booming economic growth, rapid industrialization and high standard of living of the global population demand more and more energy in different forms. Since the quantity of available energy from conventional resources is deleting day by day, development of newer or renewable energy technologies and improvement of conventional technologies become necessary to meet the energy demand in the future. While the quest for sustainable energy technologies persists to cater the need for energy, selective task group of research and development community across the globe review continually current energy consumption methodologies from energy conservation point of view and advocate for a good understanding of the mechanisms involved in every step of energy transformations from the primary thermal or mechanical energy to the end – use forms of energy like electricity for both the improvements and innovations of the technology. The world is undergoing a period of global climate change. Growing demand for energy despite limited fossil fuel reserves and growing environmental concerns due to increase emissions of carbon dioxide and methane, well-known green house gases, is undoubtedly the major challenge of the 21st century. It is of international importance that technological solutions can be brought to bear to solve these problems as well as providing alternative sources of power and energy. To achieve a sustainable development, the origin and the use of energy have to be addressed, and advanced energy technologies for both fossil and renewable energy carriers have to be developed. The continuous rise of the petrol price and natural catastrophes in the past years, have made the public aware and increasingly sensitive to energy issues and their global warming impact. The Kyoto protocol is a ray of hope for mankind with new issues and challenges for scientists and engineers to increase their efforts in research on safe, efficient and sustainable systems. Therefore, we people have to develop and test the technical and economical availability of innovative energy technologies. There is need to think globally and act locally. The adoption of new energy sources, energy carriers and better energy management will not only affect the energy market but also will have social economic and environmental impacts. New energy technologies and in particular heating and cooling technologies are decentralized and will create markets and employment essentially at a local level and, therefore, will induce a modification of individual behavior. From an economic viewpoint, new energy technologies are capital intensive sources energy and

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the present period is particularly interesting for the development of such technologies and systems due to relatively low cost of money and high cost of energy. The scientific community has not only to think and develop advanced energy technologies but also to contribute in improving the existing ones. Even if renewable energies and new energy carriers, such as hydrogen, are promising solutions, our society still relies on fossil fuels as primary source of energy for many applications. It is only by re-enforcing collaboration between the various sectors and promoting an exchange of knowledge and experience between countries that we will be able to meet the challenge of energy.

REFERENCES

[1] India energy data, static's and analysis oil, gas, coal, electricity etc updated march 2009

[2] Renewable global status report updated 2009.

[3] Survey of Indian Industry 2008 and 2009.

[4] The energy and resources institute (TERI).

[5] Energy audit reports national productivity council, India.

[6] Energy management handbook, John, Wiley and sons – W.C. Turner

[7] Overview of power sector in India 2005.

[8] Manoj Kumar Singh, Energy conversion and management pp 34-38, 2010.

[9] Chugh, Y. P., Amit patwardhan and avinash moharana 2006, US coal industry challenges; an overview, International coal congress, New Delhi, India.

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