Emerging Trends in Energy Management

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ABSTRACT

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 depleting 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. 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 increased 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. There is need to think globally but act locally. The adoption of new energy sources, energy carriers and better energy management will not only affect the energy market but will also have social economic and environmental impacts. New energy technologies and 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 of energy and the present period is particularly interested in 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 energy for many applications.

Keywords: *Energy security, implementation tariff policy, renewable energy, smart grid etc.*

1. INTRODUCTION

ESTIMATION of energy demand of various sectors and techno economic and environmental assessment of alternatives Non commercial energy constitutes 84%, met mainly by sources like firewood, agricultural residues, charcoal and cow dung, while commercial energy's share is 16%, met mainly by electricity, 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 users to shift to substantial use of agricultural residues. Bio energy users are faced with limited options of accessible and affordable fuels. Energy resources (renewable and non renewable), energy demand (sector wise), environmental, data aggregation, data analysis (energy scenarios, techno economic analysis) and integrated plan are the various modules being incorporated in the Integrated Regional Energy Plan (IREP).

The energy scenarios 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 (village / blocks/ / district / state). Environmental database is used automatically calculate environmental impacts of energy scenarios.

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.

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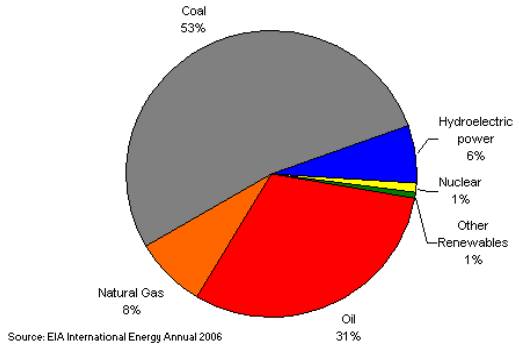

Fig. 1: Total Energy Consumption in India

Today India needs to have around 1,50,000 MW of power to meet its current energy needs, but it is able to provide only two thirds 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 environment 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 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.

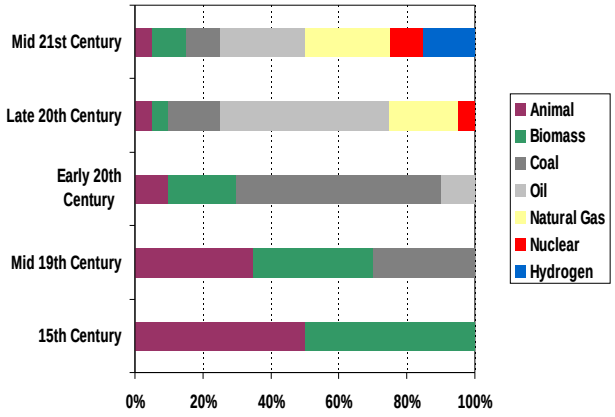

Fig. 2 : Time verses Sources of Energy

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

2.1 OIL

According to Oil & Gas Journal (OGJ), India had 5.6 billion barrels of proven oil reserves as of January 2009, the second-largest amount in the Asia-Pacific region after China. India's crude oil reserves tend to be light and sweet, with specific gravity varying from 38° API in the offshore Mumbai 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 thousand 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.[2]

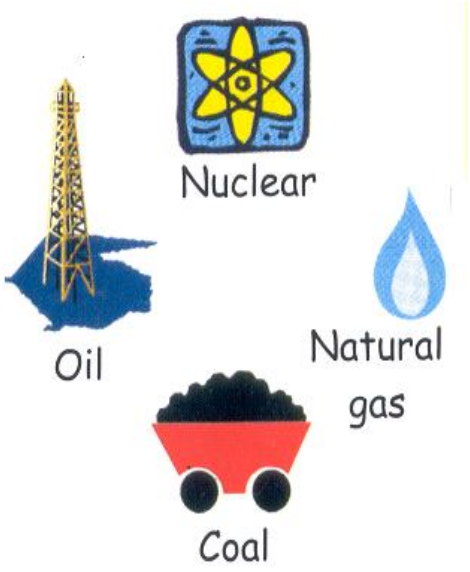

Fig. 3 : Non Renewable Sources

Although oil production in India 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. India's oil consumption has continued 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.

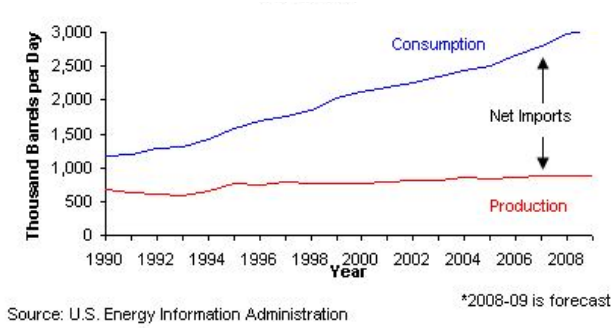

Fig. 4 : India's Oil Production and Consumption

EIA anticipates consumption growth rates flattening in 2009 largely due to slowing economic growth rates and the recent global financial crisis.[1,4]

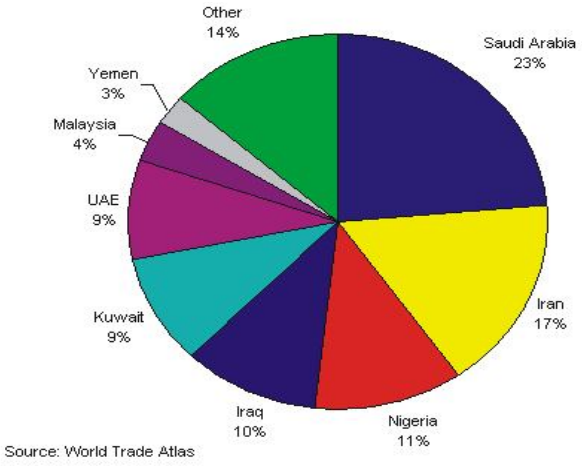

Fig. 5 : India's Crude Oil Import in 2007

2.2 NATURAL GAS

Although India's natural gas production has consistently increased, but 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 roughly 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. The power and fertilizer sectors account for nearly three-quarters of natural gas consumption in India.

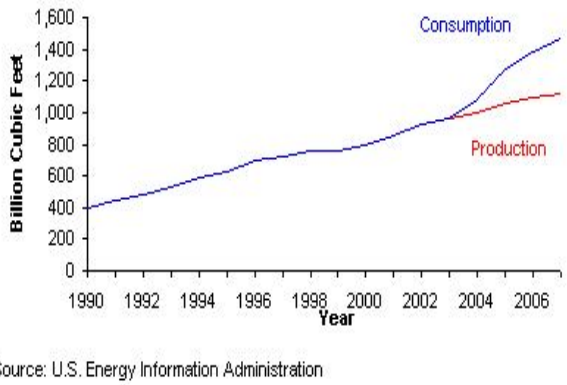

Fig. 6: India's Natural Gas Production and Consumption

3. A GLANCE AT RENEWABLE ENERGY SOURCES IN INDIA

3.1 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 of capacity of 250 to 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 [4].

3.2 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.

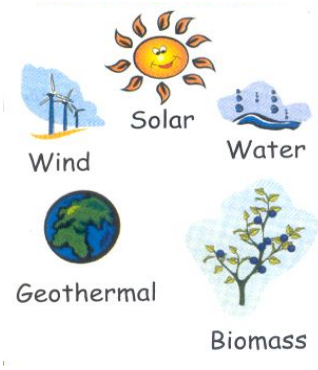

Fig. 7 : Available Renewable Sources

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 continues to boom, wind turbine 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.[5]

3.3 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 becomes major issue.

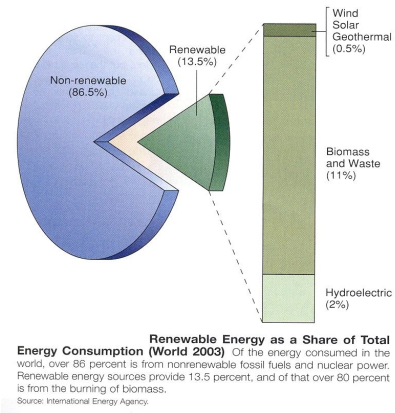

Fig. 8 : Status of Renewable Sources

3.4 BIOMASS ENERGY

Can play a major role in reducing India's reliance on fossil fuels by making use of thermo-chemical conversion technologies. In addition, the increased utilization of biomass-based fuels will be instrumental in safeguarding the environment, creating new job opportunities, sustainable development and health improvements in rural areas. Biomass energy could also aid in modernizing the agricultural economy. A large amount of energy is expended in the cultivation and processing of crops like sugarcane, food grains, vegetables and fruits which can be recovered by utilizing energy-rich residues for energy production. The integration of biomass-fuelled gasifies and coal-fired energy generation would be advantageous in terms of improved flexibility in response to fluctuations in biomass availability with lower investment costs[6,7]. Waste to energy plants offer two important benefits of environmentally sound waste management and disposal, as well as the generation of clean electric power. Waste-to-energy facilities produce clean, renewable energy through thermo chemical, biochemical and physicochemical methods. Moreover, waste-to-energy plants are highly efficient in harnessing the untapped sources of energy from a variety of wastes.

4. A GLANCE OVER DECENTRALIZED ENERGY GENERATION AND TARIFF IN INDIA

Microgeneration, also called "micro power", is the generation of zero or low-carbon electrical power by individuals, small businesses and communities to meet their own needs. The most widely-used Microgeneration technologies include small wind turbines, solar power photovoltaic or biomass conversion systems that have been promoted for decades as alternative sources of renewable energy. Because of technological advances, microgeneration now includes handheld solar and wind-power recharging devices for personal electronics, as well as advanced photovoltaic, biomass and wind-turbine systems for domestic and industrial power generation.[8,9]

Traditional "mega power" production of electricity is insufficient today because of exponential industrial growth and high living standard. Microgeneration can

act as a catalyst for cultural changes in consumer attitude, and provides evidence of the important impact that Microgeneration has on consumers' attitude and behavior regarding energy production and use. Microgeneration is both a serious form of clean energy production and also a cultural movement that is gathering momentum worldwide. Microgeneration technologies include small wind turbines, biomass gasifiers, solar power, micro-hydro, or a combination of these technologies. Prima-facie renewable energy may appear a bit costlier than the conventional source of energy, but looking at the benefit of continuous power availability and great contribution against global warming, it is worth.

Industrialized countries, like USA, Australia, Japan, have formulated action plan to foster sustainable energy to make judicious use of renewable energy resources. For example, USA has announced massive renewable energy program, to generate large share of total energy requirement from renewable energy sources by 2025, which will create 5 million new job opportunities in various areas of Renewable Energy.

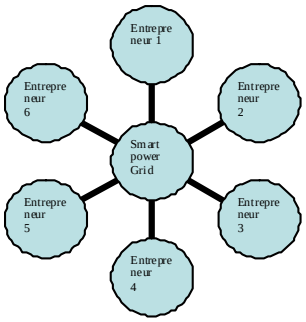

Fig. 9 : Entreprenurial Producers and Consumers in India

The ministry of power's new tariff policy would for the first time incorporate clauses that promotes energy conservation and sustainable use of ground water.

In addition to this, the long-awaited tariff policy also requires the state electricity regulatory commissions to lay out a roadmap that rationalizes retail tariffs within a narrow 20 per cent range of the average cost of supply by the turn of this decade. At present, industrial tariffs are way above the average cost while that of the farm sector are well below the costs.

The new policy, which was recently sent for comments to various incumbents including state governments and regulatory commissions, has recognized that appropriate pricing of power to the farm sector can be one of the tools for energy conservation and sustainable use of ground water resources. It outlines that tariff for the farm sector may be set at different levels for different parts of a state depending on the condition of ground water table to prevent depletion of ground water. [9]

To date, power pricing both at the retail and generation end, followed concepts that kept the viability of utilities in mind. This new orientation to the tariff policy is important as case studies in states like Maharashtra have indicated a rapid decline in ground water resources after the state government announced the free power scheme. The new policy does point out that the present Electricity Act has the necessary provisions for tariff differentiation based on geographical location.

5. RESULT ANALYSIS AND DISCUSSION

In most parts of India, clear sunny day is experienced 250 to 300 days a year. The annual global radiation varies from 1600 to 2200 KWh/Sq.m. which is comparable with radiation received in the tropical and sub-tropical regions. The equivalent energy potential is about 6,000 million GWh of energy per year. India's power sector has a total installed capacity of approximately 1,50,000 Megawatt (MW) of which 54% is coal-based, 25% hydro, 8% is renewable's and the balance is the gas and nuclear-based. India has been ranked 7th worldwide for solar photovoltaic (PV) cell production and 9th rank in solar thermal power generation. In Rajasthan, the State Government plans to establish a Solar Energy Enterprises Zone (SEEZ) in the districts of Barmer, Jaisalmer and Jodhpur.

India ranks 5th in the world with a total wind power capacity of 10,925 MW in 2009,[2] or 3% of all electricity produced in India. Muppandal village in Tamil Nadu state, India, has several wind turbine farms in its vicinity, and is one of the major wind energy harnessing centres in India led by majors like Suzlon, Vestas, Micon among others. A delegation led by Uruguayan vice president Danilo Astori visited a wind turbine factory in Chennai, south India owned by wind power company RRB Energy.

Conventional energy required may be sustainable

development for energy management. The scientific community has not only to think and develop advance energy technologies but also to contribute in improving the result analysis. Even if renewable energy and new energy opportunity such as hydrogen, are promising solutions, we are still realize on fossil fuels as a prime energy for many applications.

6. CONCLUSIONS

Energy consumption is the measure of the development of any nation. The booming economic growth demands more and more energy in different forms. Since the available energy from conventional resources is depleting, development of newer or renewable energy technologies continues to be of paramount importance. Coupling of energy and environment bring in many complexities. Much before the new technologies come into being the existing processes of conversion, transmission, and utilization have to be improved Developing Smart grid, Tariff policy, bringing it better regulation and Privatization in energy sector may turn out to be of considerable help.

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