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इरेडा न्यूज़
IREDA NEWS

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IREDA NEWS is an official publication of Indian Renewable Energy Development Agency (IREDA) under the Ministry of Non-conventional Energy Resources, brought out quarterly. It seeks to disseminate information about the activities of IREDA in promoting the use of renewable energy technologies, devices, processes, energy efficiency and conservation besides generating awareness among all concerned about the potential of new and renewable energy sources (NRSE). It also seeks to serve as a medium of interaction between IREDA and its clients and between all those interested in promising NRSE.

The views expressed in the articles are those of the authors and do not necessarily reflect those of IREDA.

'इरेडा न्यूज़' अपारम्परिक ऊर्जा स्त्रोत मंत्रालय के अन्तर्गत भारतीय अक्षय ऊर्जा विकास संस्था सीमित का अधिकृत कार्यालयी प्रकाशन है, जो कि त्रैमासिक रूप में प्रकाशित होता है। 'इरेडा न्यूज़' का उद्देश्य इरेडा द्वारा अक्षय ऊर्जा प्रौद्योगिकियों के प्रयोग के प्रोत्साहन हेतु, प्रयुक्तियों, प्रक्रियाओं और ऊर्जा दक्षता एवं संरक्षण की प्रचार सूचना के साथ–साथ नई और अक्षय ऊर्जा स्त्रोतों (एन.आर.एस.ई) के महत्त्व के संबंध में प्रचार करना है। 'इरेडा न्यूज़' इरेडा के ग्राहकों तथा अक्षय ऊर्जा स्त्रोतों के प्रोत्साहन में रुचि रखने वालों के बीच समन्वय स्थापित करने का एक माध्यम है।

इन लेखों में प्रकट विचार मूलतः लेखकों के हैं तथा यह आवश्यक नहीं है कि इरेडा भी इन विचारों से सहमत हो।

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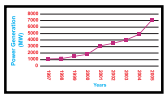

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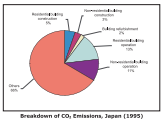

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From the Editor

What took nature to create in thousands, if not in millions, of years, in the next few decades human society would burn away fossil fuels, without any concern about the environmental and social costs of such consumption. In the years to come there will be a major shift in economies from being driven by fossil fuels to being renewable energy or hydrogen driven.

This is not just a possibility. Steps have been initiated by a group of nations with large economies to develop technologies to produce, store, transport and use hydrogen for production of power and transport – the largest sectors in the current fossil fuel consumption. The driver for such an initiative is the social and environmental costs of fossil fuel consumption.

In the years to come, energy use would be decided more by the environmental and social costs and not so much by the real costs currently being paid. The current prices of the different fossil fuels such as coal, petroleum and natural gas are fixed by demand and supply and some direct subsidy. What is not known is the hidden subsidy (sic!) cost society will pay in the near future for exhausting this precious fuel created over millions of years.

There has seen a global spurt in development and utilisation of all forms of renewable energy and India is not lagging behind. The current share of renewable energy at approximately 7100 MW is roughly 5.9 per cent of the total installed power generation capacity in the country.

Fossil fuels, mainly coal and petroleum leads to large-scale environmental degradation, loss of forests, water and air pollution, generation of wastes like fly ash and emission of greenhouse gases that contribute to climate change. Large hydropower projects may lead to submergence of lands and forest, loss of biodiversity, silting, water logging and salinity.

Findings from a number of studies show that when the external costs of any large energy project is not included in conventional energy power it tends to discriminate renewable energy power in terms of tariff and benefits. The social costs are rarely evaluated often taking the excuse of lack of data and incomplete knowledge of the related impacts.

In much the same way as gender budgeting has taken centre stage in the planning process, the time has come for social and environmental costs to get reflected in real prices. Only then will Renewable Energy Sources fill the growing gap in energy demand.

Debashish Majumdar

Shri Somnath Chatterjee, Hon' ble Speaker, Lok Sabha releasing the book entitled "SUNYA THEKE SURU" at Kolkata

LOK SABHA SPEAKER RELEASES BOOK ON IREDA CLIENT

Hon'b!e Shri Somnath Chatterjee, Speaker, Lok Sabha, released a book "SUNYA THEKE SURU" at the premises of M/s. Geetanjali Solar Enterprise on 12.01.2006 at Kolkata. Prof. A.K. Barua, former Director, Indian Association for the Cultivation of Science and Chairman, Indian Road Map on Solar Photovoltaic of Ministry of Non-conventional Energy Sources, Govt. of India, New Delhi, presided over the function.

A 22 year old organisation, Geetanjali Solar Enterprise, originally funded by Indian Renewable Energy Development Agency (IREDA), is a pioneer in the field of Solar Energy. This book "SUNYA THEKE SURU" is a compilation of different news published in the newspapers from the initiation of the organisation and also traces the development of solar energy applications from the beginning.

After releasing the book, Shri Somnath Chatterjee appreciated the total endeavour taken by Shri Anupam Baral, Proprietor of Geetanjali Solar Enterprise to popularize Solar Energy applications in the remote, non-electrified areas of the country. Besides he also took keen interest in the Solar Toys that are new in market as these toys will bring consciousness about non-conventional energy among children. Prof. A.K. Barua spoke about the bright prospect of Solar Energy all over the world and hoped that many new entrepreneurs will enter in Solar Energy field to enlighten the villages of the country.

IREDA WELCOMES ITS NEW CHAIRMAN

Presently Secretary to the Government of India since 1 February 2006, Shri V. Subramanian belongs to the West Bengal cadre 1971 batch of the Indian Administrative Service. A Commerce graduate of the University of Madras and a qualified banker, he started his career as the Sub-Divisional Magistrate at Kalna and Barrackpore during 1973 to 1975. During his stint with the Government of West Bengal, between 1975 to 1983, he was the Additional District Magistrate, 24 Parganas District and District Magistrate, Burdwan District. He also was Excise Commissioner and Managing Director of the State Cooperative Bank.

He was deputed to the Government of India in 1983 as Deputy Secretary, Department of Expenditure and was a Director in the Department of Economic Affairs during 1985-1989. In 1990 he went on a Commonwealth assignment as Adviser on Loan and Grant Management to the Government of Mozambique.

On his return to West Bengal, he was Power Secretary and Labour Secretary in the State Government.

Shri V. Subramanian came back to the Centre in February 2000 as Financial Adviser, Ministry of Civil Aviation, Tourism and Culture. In December 2004, he joined the Ministry of Rural Development as Additional Secretary and Financial Adviser, where in October 2005 he was promoted as Special Secretary.

IREDA, its Managing Director, Directors and Staff welcome Shri Subramanian as its new Chairman and commit our wholehearted support to him in leading the organisation.

ENVIRONMENT AND SOCIAL IMPACT OF RENEWABLE ENERGY

H.P. Garg*

ENERGY SCENARIO

The availability and consumption of energy is an index of prosperity of a country. We need more energy, due to population growth, industrialization, more agriculture production, and rising in living standards. The energy consumption per person in India is very low and is about 610 kwh/year whereas China is 1400, Germany 6900 and USA 13000 with world average of 2400 kwh/year. The Human Development Index (HDI) in India is also very low (below 0.6). The Human Development Index (relating education, health and prosperity) is a composite index and is directly proportional to the energy consumption per year per capita as shown in fig 1.

The present electric installed capacity in India is about 1,19,000 MW and the energy demand growth is around 8 to 9 percent per year which shows that we shall be needing around 1,00,000 MW additional capacity by 2012.

In India, about 70 percent of the population lives in villages while 70 percent of conventional power is used by urban consumers and nearly 80 percent of rural population depends on agriculture and allied activities for its livelihood. About 50 percent of the rural people live below poverty line and a vast number of these rural poor belong to schedule caste, scheduled tribe, backward classes, landless labourers, small and marginal farmers and rural artisans who can not pay electricity charges.

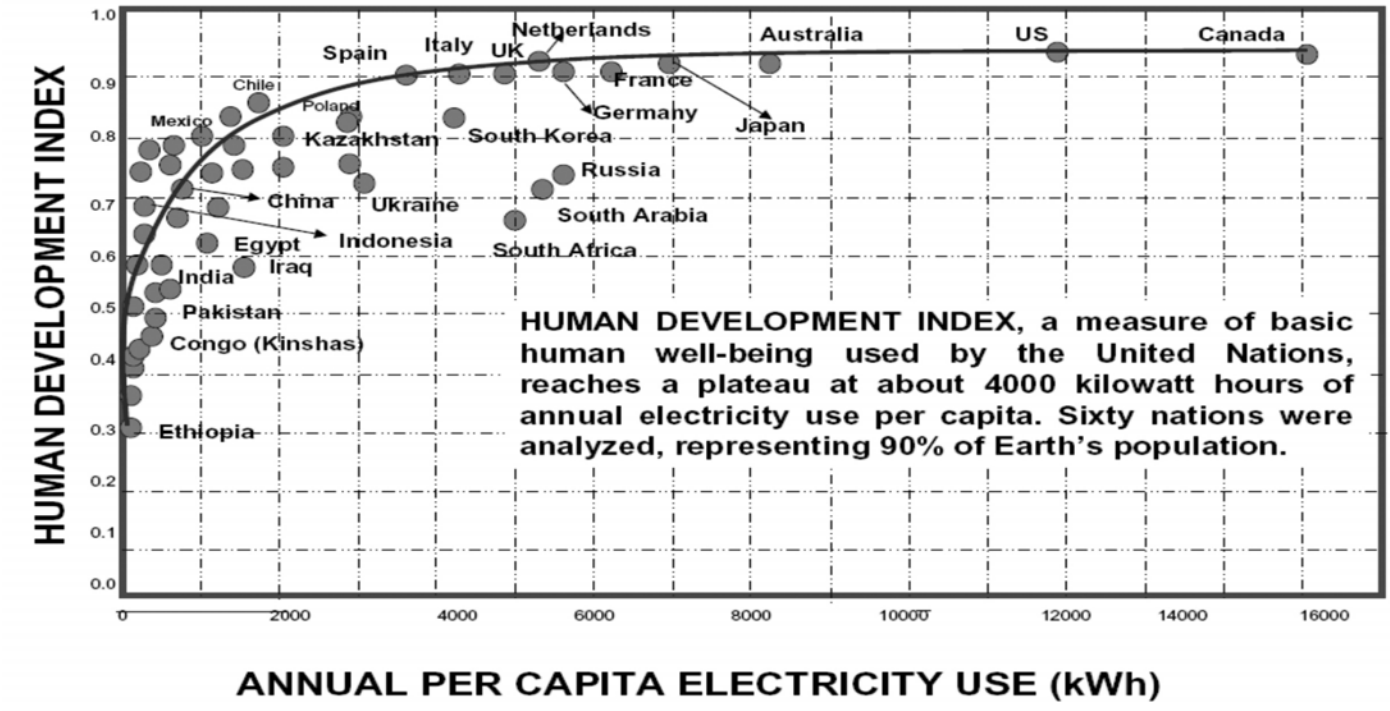

Figure 1: Human Development Index against energy consumption.

* *IREDA Chair Professor,Center for Energy Studies, IIT, Hauz Khas, New Delhi 110016*

Energy demand pattern in rural areas could be attempted in various sectors like household, commodity, agriculture and small-scale industries. Under household sector could be included end uses like cooking, lighting, heating, cooling and water supply. Under commodity sector could be included buildings, transport, lighting, water, environment and culture. Agricultural inputs like manure and fertilizers, seeds, irrigation, animal and human labour, machinery and post harvest processes would make the major demand on energy in agriculture. Under small scale industry and services could be included agro based equipment, construction industry, artisanal industry and agro-business like rice mill, and under private enterprises could be included shops, carpentry, etc.

Recently, many micro-studies have estimated energy use patterns in rural households. Most of the studies reported that domestic sector was the major energy consumer and cooking and heating consumed bulk of the energy. Since a large majority (around 80 percent) of the rural population do not have enough purchasing power, they survive on non-commercial energy sources like firewood, cow dung cakes and agricultural wastes which constitute 65%, 15% and 20% shares respectively.

The Indian energy sector is regulated, supported and owned primarily by government organizations and agencies. The Ministry of Power is responsible for perspective planning, policy formulation, processing, monitoring and implementation of power projects, training and manpower development, administration and enactment of legislation, transmission and distribution. The Ministry of Power is assisted by the Central Electricity Authority and several public sector undertakings, autonomous bodies and statutory corporations.

The main constituents on the demand side are the agricultural, domestic and industrial customers. The agricultural sector has always been subsidized. The domestic customers have also been subsidized, but not as much. The industrial sector is to pay very high prices. Tariff revisions are generally carried out on an adhoc basis, the sole criteria being the absorbing capacity of the customers.

Lack of resources and project implementation delays, led to insufficient generating capacity growth, resulting in capacity falling short of rising energy requirements.

Low plant load factor (PLF) and high transmission and distribution losses add to the supply deficit resulting from insufficient generating capacity and rising demands. India's PLF is 64.7% against an international average of over 70% owing to old inefficient plants and wide disparity in peak and non peak demands causing voltage and frequency fluctuation. Also the transmission and distribution losses are over 22%, far higher than the international standard of 7-10% because of low voltage distribution network, theft and pilferage accounting to 50 percent on National average in India.

Energy consumption by different economic sectors are as follows:

Industry	:	49 %
Transport	:	22 %
Residential	:	10 %
Agriculture	:	5 %
Non-energy uses	:	11 %
Other energy uses	:	3 %

The domestic sector is the largest consumer of energy in India accounting for 40-50 percent of the total energy consumption but bulk of it comes from non-commercial energy sources in the rural household. The overall share of commercial energy consumption in country is increasing every year. The electricity share is also increasing and it is more in the industrial and agriculture sectors as follows:

Industrial	:	35 %
Agriculture	:	31 %
Domestic	:	21 %
Commercial	:	6 %
Traction	:	2 %
Others	:	5 %

The Government of India has set up an agenda of electrifying all villages by 2007 and providing power

to all by 2012. It is following a comprehensive and holistic approach to power sector development envisaging a six level intervention strategy at the National, State, Electricity Boards, Feeder and Consumer levels. It is proposed to electrify all the un-electrified villages through grid connectivity and the remaining 25000 remote villages through the use of renewable energy technologies. The importance of optimum and economic utilization of power has been realized lately, and the present capacity of 8000 MW for inter-regional transfer is being enhanced to 23,500 MW by the end of 2007.

The new electricity bill of 2003 (Electricity Act 2003) has paved the way for delicensing of generation, non-discriminatory open access in transmission, power trading, rural electrification, mandatory requirements of State Electricity Regulatory Commissions, mandatory metering, and stringent provisions against theft of power and so on. The trading activities of the Power Trading Corporation have already commenced from surplus to deficit regions. The present installed capacity and share by different sources is shown in fig.2.

In the process of tariff setting, transparency has been brought into tariff fixation, which was traditionally a closed-door exercise. The State Electricity Regulatory Commissions have instituted measures to allocate revenue requirement in an economically efficient manner by reducing the extent of cross-subsidies. This has primarily been achieved

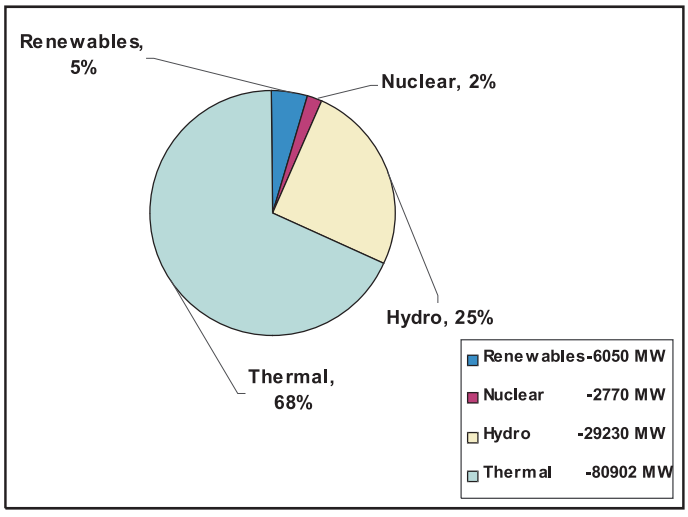

Figure 2: Present Installed Capacity in India (118,952 MW)

by increasing the low- tension tariff to a greater extent as compared to high-tension tariff. The increase in the agricultural tariff is a bold measure initiated by a number of state commissions. The commissions have issued suitable directions to the utilities along with the tariff orders in response to various issues such as quality of supply, energy auditing, and transformer failure that were faced during the process of tariff setting.

Energy security, is an issue of national strategic importance, came to take the centre stage of the planning process against the backdrop of fragment uncertainty and rise in global crude oil prices. Our dependence on fossil fuels will continue for most part of 21st century. Thus energy security will play a important role for the economic and social development of the country and also to improve the quality of life of the people. In addition, global warming, caused largely by green house gas emissions from fossil-fuel generating systems, is also a major concern. These two major issued led India to develop alternate fuels.

RENEWABLE ENERGY SCENARIO

India has taken a policy decision in 1970 to tap immense potential of Renewable Energy Sources such as Solar, Wind, Biomass, Small hydro etc. and develop required skill and trained manpower to utilize these resources initially under Department of Science & Technology (DST), Govt. of India. Later in 1989 Government of India established Commission on Additional Sources of Energy (CASE) and on its recommendation in the year 1982 Department of Non-Conventional Energy Sources (DNES) was created mainly to coordinate, development, promotion and R&D activities in the field of Renewable Energy. CASE was incorporated in 1982, in the newly created Department of Non-Conventional Energy Sources (DNES).

In 1992 the Department was upgraded to the status of a Ministry, named the Ministry of Non-conventional Energy Sources (MNES) to accelerate the deployment of RETs. In the new scheme, much greater emphasis was placed on developing market linkages and promoting commercialisation by

involving the private sector, rather than public investment, and providing more fiscal and tax incentives.

The restructuring was carried out in order to have more coordinated approach toward policies, programmes, strategies and institutions involved in the renewable energy programme, and to provide market linkages for the commercialisation of RETs. A high priority was accorded to generation of grid quality power from wind energy, small hydropower, bio-energy and solar energy. Secondly, rural energisation was undertaken through enhanced use of different RE devices.

Currently, a four-fold strategy is being pursued by the government for the promotion of RE sources through the involvement of the private sector. This includes:

- providing budgetary resources by the government for demonstration projects.
- extending institutional finance from the Indian Renewable Energy Development Agency (IREDA) and other financial institutions for commercially viable projects, with private sector participation; and external assistance from international and bilateral agencies.
- promoting private investment through fiscal incentives, tax holidays,
- depreciation allowance, facilities for wheeling and banking of power for the grid and remunerative returns for the power provided to the grid.

The current policy environment has been instrumental in creating one of the largest and most diverse renewable energy programmes in the world, with a broad technological base and large human capacity.

Over the past decade, several RE technologies have attained technological maturity, leading to commercialisation in their respective domains. The prevalent RE technologies in the country are energy through biomass, solar energy (photovoltaics and thermal), small hydro-electricity and wind energy etc.

TABLE 1: ESTIMATES OF TECHNICAL POTENTIAL FOR RENEWABLE ENERGY TECHNOLOGIES

Source/Systems	Approximate potential
Biogas plants (nos.)	12 million
Improved cooking stoves	120 million (nos.)
Biomass power	19500 MW
Solar photovoltaics	20 MW/km^2
Solar water heating area	140 million m^2 collector
Wind energy	45000 MW
Small hydro power (up to 25 MW)	15000 MW
Urban & Industrial waste based power	2700 MW
Ocean energy	79000 MW
Bagasse Cogeneration	3500 MW

Estimates of technical potential for RE as per national statistics are presented in **Table 1**.Renewable energy devices and systems have become increasingly more visible in India during the last two decades and power generation from renewable sources is also increasing. The Renewable Energy Status in power generation, decentralized systems and village electrified is shown in **Table 2**. Efforts have been stepped up to achieve the full potential of the use of renewable energy sources. The medium term goal is to ensure electrification of 25000 remote and unelectrified villages, and achieve a minimum 10 per cent share or 10,000 MW (of the estimated potential 100,000 MW), from renewable energy in the power generation capacity to be added by the year 2012.

Major programmes in India facilitated by MNES for power generation include wind, biomass (cogeneration and gasifiers), small hydro, solar, and energy from wastes. Cumulative installed capacity of RE power sources currently totals to 7097 MW, representing about six and a half per cent of the total installed capacity in India. The Ministry supports research and development with close involvement of the industrial sector. It is hoped that there will be increased interaction and close co-operation between the research and teaching institutions of the country - which are reservoirs of knowledge and experience,

TABLE 2: RENEWABLE ENERGY STATUS IN INDIA AS ON 31ST DECEMBER, 2005.

(a) Grid – interactive renewable power

Source / system	Cumulative installed capacity (MW)
Wind power	4434.00
Biomass power	376.00
Bagasse cogeneration	491.00
Small hydro (up to 25 MW)	1747.98
Waste-to-energy	45.76
Solar photovoltaic	2.80
Total	**7097.54**

(b) Decentralized renewable energy systems

Source / system	Cumulative installed capacity (MW)
1. Family-size biogas plants	38.00 lakh
2. Community/institutional/night soil biogas plan	3952 nos
3. Improved chulha	3.52 crore
4. Solar photovoltaic systems	
a. Solar street-lighting systems	54795 nos
b. Home-lighting systems	342607 nos
c. Solar lanterns	560295 nos
d. SPV power plants	1566.00 kWp
5. Solar water heating systems	1.5 million m^2 collector area
6. Solar cooking systems	
a. Box-type solar cooker	5 92 000 nos.
b. Concentrating-type community cookers	12 nos
c. Schefler/dish type solar cookers	2000 nos
7. Solar PV pumps	6818 nos
8. Wind pumps	1087 nos
9. Hybrid systems	410 kW
10. Biomass gasifiers	69 MW

(c) Remote village electrification

Villages	Remote villages / hamlets electried through RE
Remote village electrification	2195 remote villages 594 remote hamlets

and the Indian industry, which has the requisite entrepreneurship and market-orientation.

A large domestic manufacturing base has been established for renewable energy systems and products. The annual turnover of the Renewable including the power generating technologies for Wind and other sources, has reached a level of over US$ 640 million. Important achievements include cumulative capacity of SPV modules production has reached 200 MW_p, annual production of wind turbine industry is 1000 MW. India is the third largest producer of Silicon Solar Cells, and is the fifth largest wind power capacity in the world. In

SPV technology, 9 companies make solar cells, 15 companies make PV modules, and 55 companies make variety of PV systems. There are 30 manufacturers of box type solar cookers, and a few of them make community cookers and solar steam cooking systems. There are 83 BIS approved manufacturers of solar flat plate collectors for water heating, and 10 companies make equipment for small hydro projects.

The high rate of development assistance to the renewable energy endeavour requires a high rate of resource mobilisation, which the Indian Renewable Energy Development Agency (IREDA) has been instrumental in providing from various sources, including international ones, in a substantial way. Many multilateral and bilateral agencies have come forward to join this global movement for sustainable development. They include the World Bank (WB), the Global Environment Facility (GEF), the Danish International Development Agency (DANIDA), the Swiss Agency for Co-operation and Development (SDC), the Asian Development Bank (ADB), German Bank for Reconstruction (KfW), and the Government of the Netherlands etc.

A number of States in India have announced policy packages including wheeling, banking, third party sale and buy-back, and a few of them are providing concessions or exemption in state sales tax and octroi. These rates vary from state to state for different technologies and devices and in periodicity. Fourteen states have so far announced policies for purchase, wheeling and banking of electrical energy generated from various RE sources.

Power generation through renewables in India is considered to be more useful for sustainable development and the estimated potential is about 80,000 MW. Electricity generation through these sources like Wind, Small hydro and Biomass is becoming increasingly competitive. The challenge is to bring renewable-based power generation in the mainstream in terms of efficiency, reliability, cost and quality. The installed capacity from grid-interactive renewable power has gone to 7097.54 MW by the end of 31st December 2005 which comes to about 6.5 percent share of the total installed capacity in the country. The cumulative progress during 1997-2005 (end) is shown **fig 3**.

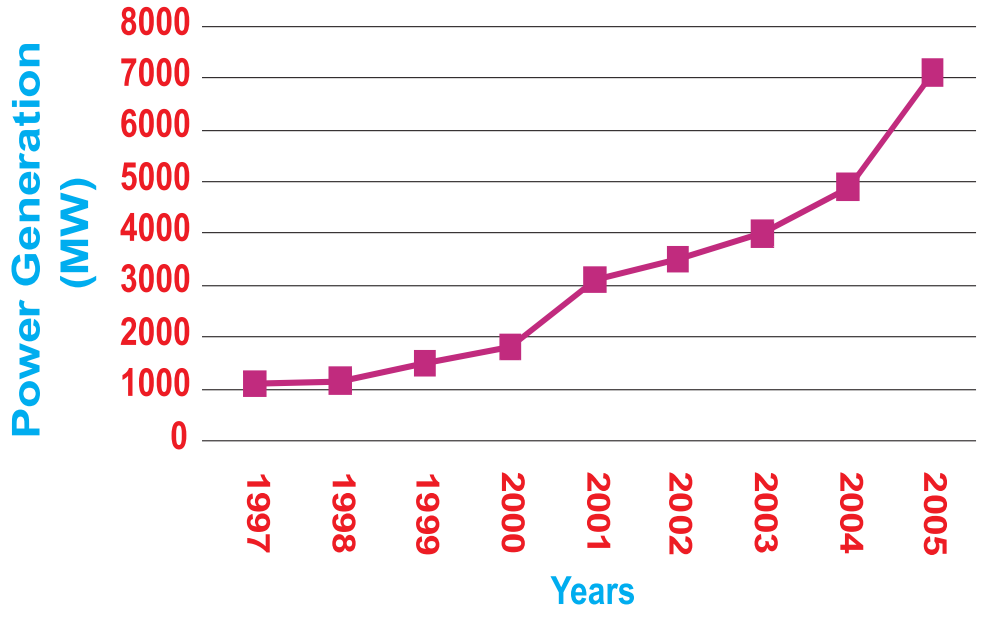

Figure 3: Installed Power Generation Capacity in India from Renewables (1997-2005)

The major contribution in Grid power from Renewables is through wind energy as is seen in figure 4 which is 4434.00 MW (by 31st Dec., 2005).

IREDA which is the only and leading financial institution in India promoting Renewable Energy, energy efficiency and energy conservation on commercial basis has made a significant dent in the Renewable Energy Power scene in India. The progress is highlighted in **Table 3**.

IMPACT OF RE

Due to policy intervention, the promotion

TABLE 3: HIGHLIGHTS OF CUMULATIVE LENDING OPERATED BY IREDA (AS ON 31.3.2005)

Number of project approved	1736
IREDA's loan commitment (million Rs.)	6945
Loan disbursements (million Rs.)	3715
Power generation capacity sanctioned	2545 MW
Conventional fuel replacement MTCR / year	10.94 lakhs

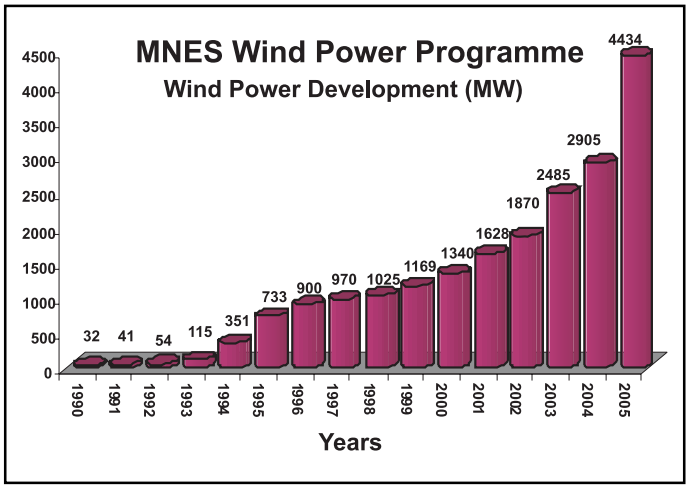

Figure 4: Wind power development in India.

of renewable energy technologies got momentum due to a number of reasons such as technology maturity, cost reduction, external funding and feeling of social and environmental benefits. It is a feeling that socially oriented programme like biogas, improved cookstoves, solar cookers and integrated Rural Energy Programme (IREP) may be useful as a local energy source but not be able to improve the quality of life of the people but the market oriented Programme for power generation (grid connected) like wind energy, small hydro and biomass may have impact on environment and human health.

Establishment of R&D institutions, funding of R&D projects, incentives for demonstration of projects, standardization for quality and performance maintenance and technology transfer have resulted only in establishing large number of industries in all the areas of Renewable Energy Technologies and have not resulted any visible impact on cost reduction, import substitutation and quality product.

The financial and fiscal incentives which are in the form of capital subsidy, interest subsidy, concessional loans, tax holidays, sales tax and customs tax exemptions and concessions, accelerated depreciation, etc. through Ministry of Non-Conventional Energy Sources (MNES), Indian Renewable Energy Development Agency (IRDEA), several government and private banks, agencies and NABARD and providing fiscal incentives to corporate houses and potential investors in private sector have definitely made an impact in pushing the Renewable Energy Programme in India. IRDEA's role in RES is laudible since it has not only mobilized international funding, international repute but also made visible impact in the Renewable Energy Power scenario in India.

MNES has made innovative efforts by establishing state nodal agencies, R&D centers, regional test centers, financial institutions, training institutions etc. for creating institutional infrastructure, capacity building, establishing linkage between manufacturers and awareness creation, etc. but has made marginal impact in the availability and utilizablity of the Renewable Energy Technologies and have also failed in creating skilled manpower both in technical and financial field because of lack of coordination, expertise and resources.

The regulatory interventions by some states allowing wheeling, banking, third party sales and buy back arrangements for power projects in the Renewable energy sector have made a significant impact in India even when there is no level playing field vis–a–vis conventional power.

It is needless to say that India needs more power for development and in 21st century it will mainly depend on fossil fuel and traditional biomass fuel leading to increase in emission of pollutants, deterioration in air quality particularly in cities, deforestation and land degradation. Therefore, the primary objective should be apart from generating and utilizing more power, we should consider the environment and socio-economic impact of energy consumption pattern. The conventional fuel mainly

coal and hydro used for electric power generation in India are to be considered at par with alternatives for power generation interms of environment pollution and social effect.

Coal extraction, beneficiation, processing, transportation and combustion are shown to lead to large-scale environmental degradation, loss of forests and land degradation, water pollution, air pollution (potentially acid rain), generation of waste (fly ash) and emission of green house gases (GHGs) contributing to climate change. Hydro-electric river valley projects lead to submergence of land and forests, loss of biodiversity and land degradation in the catchments due to shifting of pressure (grazing and extraction), water logging and salinity.

CO_2, a GHG emission from the energy sector, is projected to increase by over five times during 2000-2020 and is likely to become a significant proportion of global GHG emissions. Fuel wood extraction contributes to forest degradation and even deforestation to some extent, though it is not the main contributing factor. Combustion of fuel wood in kitchens, with no facility for removal of smoke, exposes women and children to pollutants affecting their health.

The main barrier for the large scale exploitation of Renewable Energy Technology (RET) is the initial cost compared to the conventional systems. Although the costs decrease with market penetration and technology development. This statement appears to be true on cost considerations when external costs like environment degradation and social costs are not considered. Here we shall try to consider both the Direct cost (private cost) and External cost (damage on environment and human health) for power

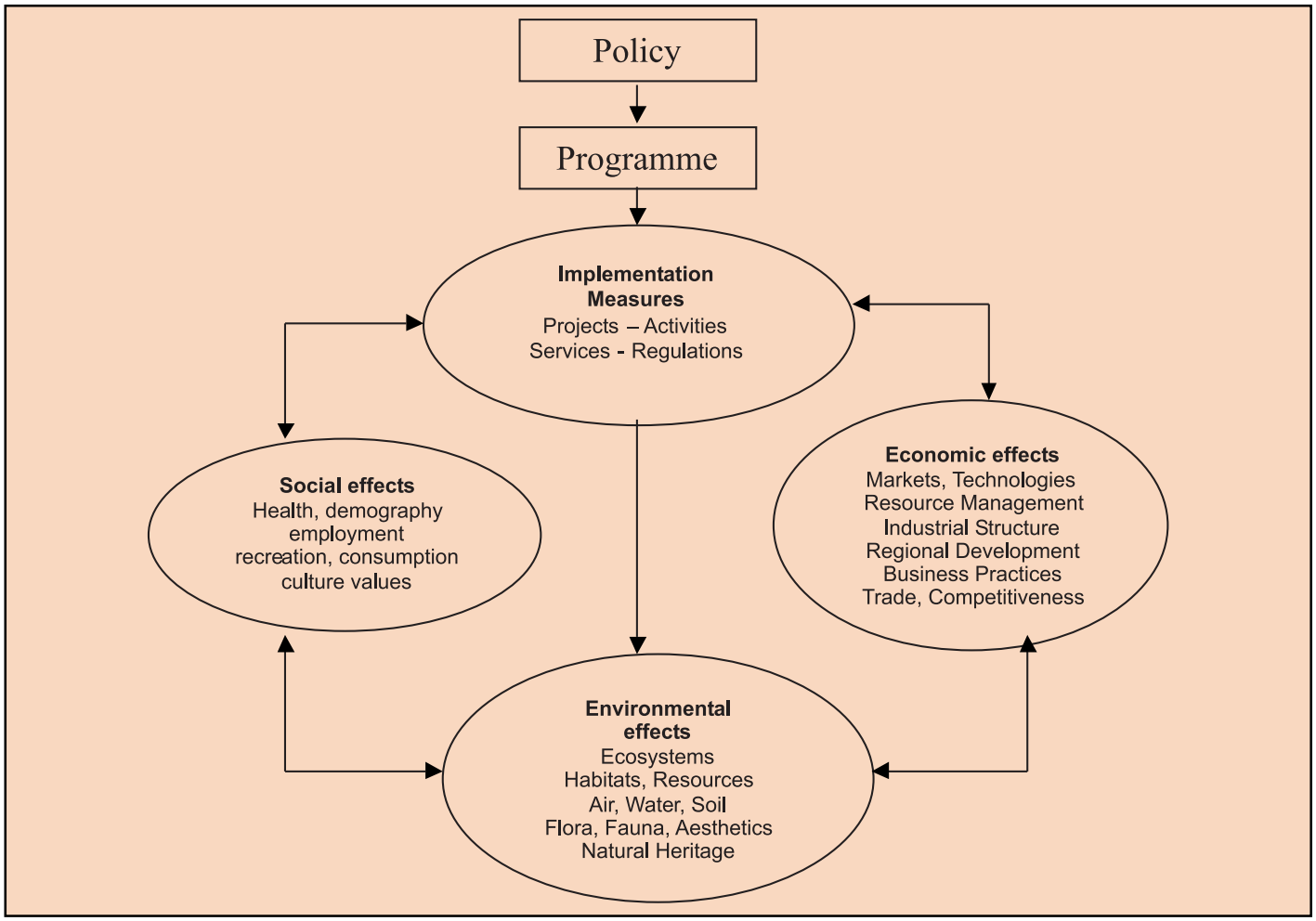

Figure 5: Environment Impact Assessment Scope

production by both conventional means and Renewable Energy means. The scheme is shown in **Figure 5**.

The formula for the annual social cost (SC) can be the sum of the annual external cost (EC) and the annual private cost (PC) for any Conventional or Renewable power plant:

$$SC = EC+PC$$

$$= \sum_i Ei\ (Ci + Di) \qquad (i)$$

Where Ei is the quantity of electricity produced from a specific power plant of type (i) and Ci the corresponding private cost figure and Di is the total external cost figure per energy unit estimated.

The private cost factor (C) on a kWh basis taking into account the annual electricity production (E) by a particular power plant can be calculated as:

$$C = \frac{I + M + F}{E} \qquad (ii)$$

Here F is the fuel cost, M is the operational and maintenance costs and I is the investment cost reduced on an annual basis.

For conventional power plants, the cost of the fuel used is a major factor while for RES power plants the initial cost is the major factor. Thus the total annual private cost (PC) for a particular power plant can be given as :

$$PC = \sum_i Ei\ Ci \qquad (iii)$$

The externalities (or external cost) associated with different types of power plants are calculated based on the report prepared by European Commission of 1995. This mainly comprise damage costs due to the impacts of the atmospheric pollution on human health, agriculture, forests and materials as well as other impacts on human amenity, occupational health, biodiversity and climate change. Thus external cost relates to damages on the society due to side effects of power production. Social cost is not generally included in the private cost of electricity including damages to environment and human health due to air pollution and occupational accidents. There are other associated parameters such as microeconomic impacts such as job creations, price stability, charges in gross value added, security of energy supply and resources depletion. It is difficult to estimate all these damages due to lack of data and incomplete knowledge about the type and magnitude of the related impacts.

The Damage Function Approach (DFA) as discussed in the report of European Commission (1995) is a step-by-step analytical procedure examining the sequence of processes through which emissions or other burdens associated with a particular polluting source result into environmental damages. This analysis depends on the fuel cycle concept considering the fuel type and its flow from extraction to power production. The fuel cycle concept is not applicable in case of Renewable Energy Systems (RES) since these are available at the place of use and therefore the concept of Life Cycle Analysis (LCA) is adopted in RES. The physical impacts are translated to monetary terms by means of different valuation techniques derived from welfare economics using direct and indirect approaches. It is clear that there can be a high level of uncertainty due to limited knowledge on the physical processes involved in this impact pathway and the lack or variability of data and models. Inspite of these limitations the above model gives the approximate impact of power generation systems on human health and environment.

Using the above model several studies have been conducted in European Union including the Crete, a large island in the Mediterranean. Crete has a potential of utilizing wind, biomass and solar energy for electricity generation and presently producing electricity of about 650 MW using conventional power plants. The RES power generation unit consists of 150 MW wind power, 30 MW biomass fired unit and small hydro units of 6 MW capacity. Cost estimates are carried out for all the conventional and RES systems assuming average life expectancies, discount rates, investment costs, fuel costs etc.

A comparative view of the externalities estimated for conventional and renewable technologies clearly reveals that power plants using conventional fuels produce significantly higher external costs compared to those based on RES exploitation. Moreover, the social costs of

TABLE 6: RENEWABLE ENERGY : BASIC ISSUES TO BE ADDRESSED

1.	Initial cost, financial viability and financing mechanisms	•High initial (capital) cost •Site and application /case specific financial viability. •Unavailability of attractive financing mechanisms
2.	Restricted availability of different type(s), size(s) of renewable energy devices to suit user taste / need / demand.	
3.	Reliability, durability, repair and maintenance, standardization (quality assurance) and credibility related issues:-	•Usually unreliable (problem(s)) of resource availability and technological appropriateness. •Technologies being disseminated are not durable (wrong choice of materials, design) •Absence of maintenance infrastructure, after sales service
4.	Relevant Environmental issues	•Potential of reduction in greenhouse gas emission •Clean development mechanism
5.	Policy measures, absence of level planning field for RET's	•Prioritization •Pricing of fossil fuels vs. promotional measures for renewables
6.	Identification of Niche areas for each technology and formation and implementation of specific measures	
7.	Lack of awareness, education and training, Human Resource Development	•Mass level awareness programmes •Education of policy makers, administrator •Education of technicians, mechanics •Employment related issues
8.	Support to research and development to develop and disseminate appropriate renewable energy technologies	•Identification of problems and provide solutions / remedial measures

renewable technologies (in case of wind power and small hydro) examined are either lower or very close (in case of biomass) to those estimated for the conventional units. Thus the net effect of not taking into account the external costs associated with electricity generation through conventional means is to discriminate RES and favour conventionally generated electricity. Thus there is a strong need to introduce policies at the local, national and international level for promoting RES for electricity generation for sustainable development. Some of the issues which needs to be addressed at the National level are discussed in Table 6.

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SOCIO-ECONOMIC & ENVIRONMENTAL IMPACT STUDY OF BIOMASS POWER & COGENERATION PROJECTS IN TAMILNADU

J. Srikanth & D. Swamy*

EXECUTIVE SUMMARY

India has today the world's largest programmes for renewable energy. The cumulative renewable energy achieved, as on 31.3.2003 is 4,063.34 MW. The cumulative achievement in wind power, small hydropower, biomass power/Cogeneration, biomass gasifiers, solar photovoltaic and energy recovery from urban and industrial waste are 1,870 MW, 1,509.24 MW, 483.90 MW, 53.40 MW, 121 MW and 25.80 MW respectively.

Biomass based power generation is emerging as an attractive option to meet the growing energy demands in India. Also, India is the largest producer and consumer of sugar in the world with a record production of 201 lac tons and consumption of 184 lac tons in 2002-03 and hence the opportunity for an extensive cogeneration programme in the sugar belt of the country, in the States of Tamilnadu, Andhra Pradesh, Karnataka, Uttar Pradesh, Maharashtra and Punjab. In India, the total power generation potential from biomass power/ cogeneration is estimated to be 19,500 MW, which comprises 16,000 MW from surplus biomass materials and 3,500 MW of power from bagasse-based cogeneration. The total installed capacity achieved from biomass power/cogeneration projects as on 1.7.2003 is 537 MW, which comprises 189 MW of biomass power and 348 MW of cogeneration power. Also, biomass power/cogeneration projects totalling 536 MW capacity are under various stages of implementation.

Tamilnadu is playing a major role in the adoption of biomass power generation and cogeneration in the sugar industry. Tamilnadu has the highest installed capacity achieved from commissioned cogeneration projects in sugar mills and it has the potential to produce 350 MW of power through bagasse based cogeneration in the existing sugar mills. Hence, as a part of the promotional and monitoring activity, IREDA wanted to conduct this study entitled "Socio-economic and environmental impact study on Biomass Power/ bagasse-based Cogeneration projects funded by IREDAand located in Tamilnadu" and the project was assigned to Dr. GRD College of Science, Coimbatore. The seven projects identified by IREDA for the study are Rajshree Sugars and Chemicals Ltd. (12 MW), Dharani Sugars and Chemicals Ltd. (15 MW), Supreme Renewable Energy Ltd. (40 MW), Auro Energy Ltd. (16 MW), Arunachalam Sugar Mills Ltd. (18.4 MW), Thiru Arooran Sugars Ltd. (Terra Energy Ltd 18.68 MW at A. Chittur) and Mohan Breweries and Distilleries Ltd. (12 MW). The first three projects are bagasse based cogeneration projects and the last one is a biomass power projectof Mohan Breweries and Distilelries Ltd. All the projects are funded by IREDA and are located in Tamilnadu.

The detailed study had four dimensions viz. energy, social, economic and environmental. The specific aspects of the study were –

- Power demand and supply pattern, capacity augmentation, transmission and distribution pattern, voltage stabilisation, and other grid related aspects and finally the scope for revenue augmentation.

- The social aspect which attempted to analyse the changes in cultural aspects, education, health, quality of life, displacement effects and aspects likely to transform society. These included community development, irrigation and agricultural patterns, infrastructural development including roads, canals, transportation facilities, rural electrification and tourism.

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- The economic aspects which quantified the income generation and employment aspects of the projects, both direct and indirect through the operation of linkages, backward and forward.

- The study attempted to analyse both tangible and intangible benefits. These included change in income levels, employment patterns, regional development aspects, industrial development and entrepreneurial aspects. The study also attempted to analyse changes in production patterns including changes in land-use pattern. Changes in the consumption patterns were also analysed.

- The study attempted to analyse environmental conditions, impact of the project on the flora and fauna, water quality and pollution, air quality and emissions based on the baseline survey. It also studied deforestation and energy plantation and visual environment besides analysing the overall impact on human health

The aspects were studied in the pre and post project scenario taking into consideration both positive and negative impact of the projects in the study area.

The study consisted of three parts:

1. Survey of project promoters of biomass power, biomass/bagasse based cogeneration projects funded by IREDA and located in Tamilnadu.

2. Survey of villagers/farmers/traders from nearby villages, where these power projects are located.

3. Collection of primary data and secondary date from various stakeholders and organisations.

The Survey method was adopted in the first two cases and to facilitate data collection, two types of questionnaires were developed in English. For the survey of villagers,the Tamil version of the questionnaire was also prepared. All the questionnaires were duly approved by IREDA. The respondents were personally contacted and the relevant information collected.

The major limitations of the study are, in the case of cogeneration projects, the social and infrastructure developments in and around the project area are due to both the sugar mill and cogeneration project and it is difficult to separate the benefits and three of the cogeneration projects taken up for study were commissioned very recently and they are less than one year old and hence too early to assess the socio-economic impact due to these projects (most of the social and infrastructure developments in and around these projects could be due to the sugar mill.

The important findings of the study are:

1. In the case of bagasse based cogeneration projects, the direct employment potential at the time of erection and commissioning is about 100-150 persons for about 6-12 months and after implementation, the direct employment potential is about 50 persons for a typical 2,500 TCD sugar mill cogeneration project. An independent biomass power project involves more employment opportunity than a bagasse based cogeneration project in a sugar mill.

2. Both cogeneration projects and biomass power projects have improved the availability, quality and reliability of power in the nearby areas, especially in the rural feeder and this has helped the farmers in more irrigation and more farming operations. This has also reduced the instances of burn-out of farmers' motors. In addition, small scale industries that depend on power have come up due to better availability, quality and reliability of power compared to earlier days.

3. Both cogeneration projects and biomass power projects offer opportunities for farmers to sell biomass fuels such as fireqood (eucalyptus, casuarina, velikathan, etc.), groundnut shells, paddy husk, cashewnut shells, coconut shells, etc. at remunerative prices in addition to wasteland development by taking up planation of fuelwood crops/trees.

4. Many petty shops, tea shops, small restaurants, provision shops and STD booths have come up in the vicinity of cogenration projects/biomass power project. Few automobile workshops, automobile fabrication shops have also come up

to cater to the maintenance of lorries, tractors and other vehicles.

5. There has been no negative environmental impact due to cogeneration projects/biomass power project. No deforestation, displacement/ resettlement/rehabilitation, major types of diseases, adverse impact on flora and fauna, increased levels of sound, water and air pollution have taken place due to these power projects.

6. Almost all the cogeneration projects that have been studied are not using biomass fuels other than bagasse in large quantities either during season or during off-season. They prefer to use their own bagase during season and imported coal or lignite during of-season. This practice should be changed and more biomass fuels should be used during off-season and the use of fossil fuels like coal and lignite in the off-season should be phased out.

7. An independent biomass power project is more risky compared to a bagasse based cogeneration project in sugar mill because in the case of a biomass power project procuring biomass fuels throughout the year is a big challenge. Effective fuel management is a critical function for efficient operation of biomass power plant. The biomass fuel requirement is about 12,000-15,000 tons per annum for generating 1MW power. Hence arranging for biomass fuels of the right type, the required quantity, quality and at the right price, on a continuous basis without any captive source is a very challenging task.

The following suggestions were made to improve the socio-economic benefits to the local community due to the cogeneration projects/biomass power projects.

1. Promoters of cogeneration projects/biomass power projects could take up development of wastelands in the nearby areas by growing firewood trees such as velikathan, casuarina, eucalyptus, etc. either by motivating local farmers or by themselves by leasing out large areas of government land. If this happens, even in a small measure, it will lead to massive rural employment, increased income levels and other socio-economic developments. There is a lot of synergy between wasteland development and biomass power projects/cogeneration projects.

2. Small biomass power projects with 1-2 MW capacity in 3-4 taluka clusters hold the biggest opportunity for rural employment, better availability, quality, and reliability of power in the rural feeder apart from other socio-economic benefits. High surplus biomass available taluks should be identified through the National Biomass Resource Assessment Porgramme and the Biomass Resource Atlas of India being developed by MNES and the State Nodal Agency should market these projects to the prospective promoters.

3. Cogeneration projects should use more biomass fuels during off-season and the use of coal and lignite in the off-season should be phased out. If this happens, farmers in the neighbouring areas will have more opportunity to sell biomass fuels and this will lead to more employment and economic benefits. To encourage cogeneration projects that intend to use only biomass fuels, IREDA can offer loans at concessional rates or MNES can offer additional interest subsidy.

Finally favourable policies such as fiscal incentives, interest subsidy, capital subsidy by central and state governments, SEB on power purchasing rate, wheeling, banking, third party sale, etc. are a must for development of cogeneration in sugar mills and biomass power projects in Tamilnadu. Many promoters feel that there has to be some benefit for producing green power. ❑

This report is the Executive Summary of the findings of an IREDA study conducted in the year 2003

SOCIO-ECONOMIC & ENVIRONMENTAL IMPACT STUDY OF BIOMASS POWER & COGENERATION PROJECTS IN A.P

K.C. Reddy and others*

EXECUTIVE SUMMARY

Since 1994-95 IREDA has funded 27 projects, 10 cogeneration and 17 biomass power projects located in Andhra Pradesh with a total installed capacity of more than 200 MW. These units are spread among all the three regions of the State, coastal Andhra, Telangana and Rayalseema. Most of the the units are located in rural and semi-urban Andhra Pradesh. The study limited itself to 19 units, as three units have not commissioned their operations, three units have just commissioned their operations and two units did not provide data or information. However, given the distribution of these units between activities and among the regions, we consider them representative and it would be safe to take the results as being meaningful.

An analysis of the 19 power projects funded by IREDA and located in Andhra Pradesh help us conclude as follows.

BASIC CHARACTERISTICS

- Most of the units are located in the rural and semi urban areas. Therefore the location of these units is expected to contribute to the overall development of the rural areas in terms of industrialisation and development of services apart from strengthening agriculture.
- The land acquired for these plants ranges between four and 60 acres. Most of the land is barren, unirrigated land except in coastal Andhra where irrigated land is acquired for these plants.The location of these plants did not affect the land use patterns. In contrast these projects helped to provide demand for agricultural waste.
- 12 units are biomass power and 7 are cogeneration projects.
- Capacity of the units vary between 4 MW and 20 MW and the medium capacity is 6 MW for both biomass power and cogeneration units.
- The project cost of the units vary between Rs.13.69 crore for a 4 MW cogeneration unit to Rs.56.03 crore for a 20 MW cogeneration project.
- Most of these plants are using rice husk as basic fuel. Agricultural crop residues and wood wastes are the alternate fuels.
- There is no significant difference in terms of performance by ownership.
- More than 90 percent of these units are selling power to APTRANSCO and the rest are selling to Third Party.
- Technical education background appears to be the major influencing factor for entering into this activity, together with experience either in a similar line or different line.
- 11 units are running below average and 8 units are above average in terms of their performance.
- 10 units depend on river water and 9 depend on borewells.
- Cogeneration power plants appear to be performing better as 5 out of 7 are performing better than average. In contrast two-thirds of the biomass power power projects are performing below average.
- Most of the promoters expressed that the actual fuel prices are more than envisaged. The prices

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are increasing continuously due to mismatch between demand which has been increasing continuously and inadequate supply consequent to the failure of monsoons.

ECONOMIC IMPACTS

- The analysis clearly establishes that performance of above average units is better than below units. The per unit cost is inversely related to performance. Thus a high per unit cost indicates a poor performance and a low per unit cost denotes a better performance. Efficiency is directly related to performance, implying that a higher performance is directly asociated with higher efficiency. combination of factors such as cogeneration, ownerships, units with qualified technical personnel with bsuiness experience in the same line, selling power to a combination of APSEB and Third Party, situated away from town with grid convenience, land and water availability might have helped the above average performance units to attain a lower per unit cost and higher efficiency.

- The number of labour employed, unskilled, male and female as well as total labour are more in the pre-project stage but the salary paid in general is high in the post project period. However, a higher number of skilled labour are employed in the post project stage.

- Petty trade, coffee and tea shops have grown in significant numbers thus exhibiting strong linkages.

- Overall, there seems to be a positive impact of the project on the spread of industries.

- The impact of these units on growth centres does not appear to be significant.

- Availability of raw material appears to be a key determinant. Given the seasonality of the basic agricultural activity which in turn depends to a large extent in the monsoon, entrepreneurs appear to be looking for alternate fuels having serious implications on both the viability of the projects and the sustainability of the project on the environment. Water availability is another aspect influencing the performance of the units.

SOCIAL IMPACT

- The positive impact of the project on the educational facilties and literacy is clearly evident when pre and post status of these variables are examined. In the pre project period primary schools were more in number in below average units but in the post project period more of them ae nearer to above average units. A large number of higher secondary schools are nearer to below average performing units in the pre-project stage and they continue to be there. Male and female literacy rates have shown to rise with the project coming up.

- Medical facilities in general improved from the pre-project stage to the post project stage. This is true of private practitioners, primary health centres, dispensaries, charitable hospitals and government hospitals.

- The quality of health which depends upon drinking water - from well, tubewell and pipes, remained unchanged from the pre to the post project stage. The water level in the areas had no impact because of the grounding of the project. The quality of roads improved as pucca and metalled roads have replaced kuchha roads in some areas while train facilities remained the same.

GRID RELATED ISSUES

- The below average performing units had access to limited variety of substation capacities while above average performing units had access to substations with varying capacity. Overall grid stability improved from the pre-project 18 percent to the post project 73 percent. System upgradation at 36 percent and modernisation at 64 percent was on a massive scale in the pre-project stage. Hence the activities are on a low key in the post project stage with 64 percent of already upgraded and modernised system

remaining normal. These improvements would not have happened but for these projects.

- The average hours of power availability improved from pre-project to post-project stage for all groups - above average and below average. Correspondingly, the breakdown frequency has come down for all groups. Transmission and distribution losses too may have been minimised. The number of villages electrified, number of electrical connections - domestic, agricultural and industrial have increased across the above and below average groups. However the quality of power at the user end is high for above average performers than for the below average performers.
- Sale to Electricity Boards is a crucial determinant of performance as it provides not only an assured market but a good price.

ENVIRONMENTAL IMPACTS

- From the study it was observed that the units under survey are all aware of the environmental implications of these activities and they have all been following the required practices, albeit with lesser rigour and intensity. Considering the fact that input use is changing in most of the cases, a more rigourous monitoring of the gases and metals by the units is suggested.
- The water table went down slightly from 70 metres to 72 metres from pre-project to post-project stage. It is also clear that the quality of ground water is normal in about 90 percent of the cases.
- Noise levels appear to be high in two project sites as most of the values are higher than the prescribed standards for industrial areas. The levels reported in some projects are lower than those prescribed for residential areas.
- During the year due to lack of adequate rice husk supply, most of the units have taken to wood as the basic fuel. There is an apprehension that this may perhaps lead to deforestation in the State. This has to be viewed against the fact that this year is not a normal year, with the rains failing.
- There is a need to monitor noise levels properly in the industry where most of the workers are present and in nearby residential areas which are likely to experience increased activity due to the presence of agro-industries and cogeneration units.
- It is necessary that monitoring of SO_2, NO_2 and CO also alongwith SPM is done more regularly especially when there is a change in the nature of fuel. Since the moisture and ash content in some fuels is high, they will hamper the efficiency of boilers and load to increased concentrations of CO_2 and CO. The need for regular monitoring of air quality is felt since projects are monitoring the levels once in a year. Monitoring should be done once in 15 days or a month.
- The impact of the projects on social forestry however seems to be positive. Most of the units are using surplus land to develop green belts besides growing horticulture crops. Some of the units also encourage the local farmers to grow fuelwood trees by providing extension services to ensure adequate supply of fuelwood.
- It is felt that monitoring of SO_2 and NO gases in the stack and ambient environment will lead to improvements in air quality.

PERCEPTIONS

The establishment of projects has had positive impact on education,literacy, health and living standards. It has also helped in social upliftment of women, spread of community activities and reducing migration to some extent. It has improved income levels of people living near the project sites. Pollution levels are as normal. So are cropping patterns and levels of deforestation. It is concluded that biomass power and cogeneration projects in Andhra Pradesh has contributed positively in both economic terms and social infrastructure. Availability of power and its quality have improved, while environmental concerns need to be addressed. A proactive policy would sustain the sector. ❑

This report is the Executive Summary of the findings of an IREDA study conducted in the year 2003

SOCIAL AND ECONOMIC BENEFITS OF RENEWABLE ENERGY USE IN BUILDINGS

Anil Misra*

"Architecture presents a unique challenge in the field of sustainability. Construction projects typically consume large amounts of materials, produce tons of waste, and often involve weighing the preservation of buildings that have historical significance against the desire for the development of newer, more modern designs." — The Earth Pledge (www.earthpledge.org)

The built environment has major impacts not only on economic and social life but also on the natural and built environment. Various building activities such as the design, construction, use, refurbishment and demolishment of buildings directly or indirectly affect the environmental performance of this sector. It is also well understood that we can maximize both economic and environmental performance by adopting green building strategies.

The impact of the building sector on energy use is not limited to energy used for the operation of buildings. A considerable amount of energy is also used in construction activities, including the manufacturing and transportation of building materials. The present world energy scenario shows that over 50% of commercial energy is used in building construction and maintenance and operation. Further break-up of this energy shows that about 85% is operational energy and only 15% is embodied energy (**Figures 1 & 2**)[1]. In Japan, it was estimated that construction activities, including refurbishment work, account for about 10% of total CO_2 emissions (**Figure 3**)[2]. Since the biggest share of energy use in building sector is attributable to the operation of buildings, it is crucial to improve the energy efficiency of buildings. This generally means reducing the quantity of energy required to satisfy certain needs in terms of internal environment and services, and it is here that designers must maximize the use of renewable energy technologies and sources.

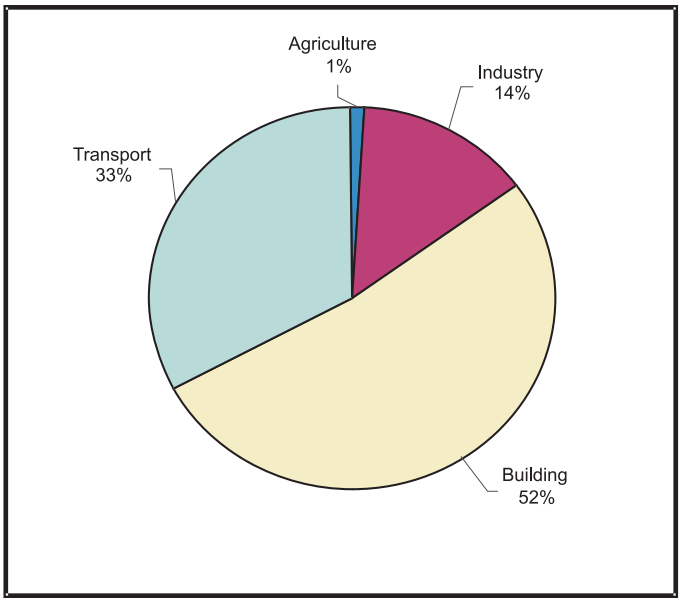

Figure 1: World energy consumption (1995)

Sustainable design based on green construction methods can be integrated into buildings at any stage, from design and construction, to renovation and deconstruction. However, the most significant benefits can be obtained if the design and construction team takes an integrated approach from the earliest stages of a building project. Potential benefits of green building can include:

Environmental benefits

- Improve air and water quality
- Reduce waste streams
- Conserve and restore natural resources

[1] *Sustainable Building Design Manual, Volume 2* (2004) – Published by TERI (The Energy and Resources Institute), New Delhi Chapter 6, Page 57 [2] *Environmentally Sustainable buildings – Challenges and Policies*, OECD 2003

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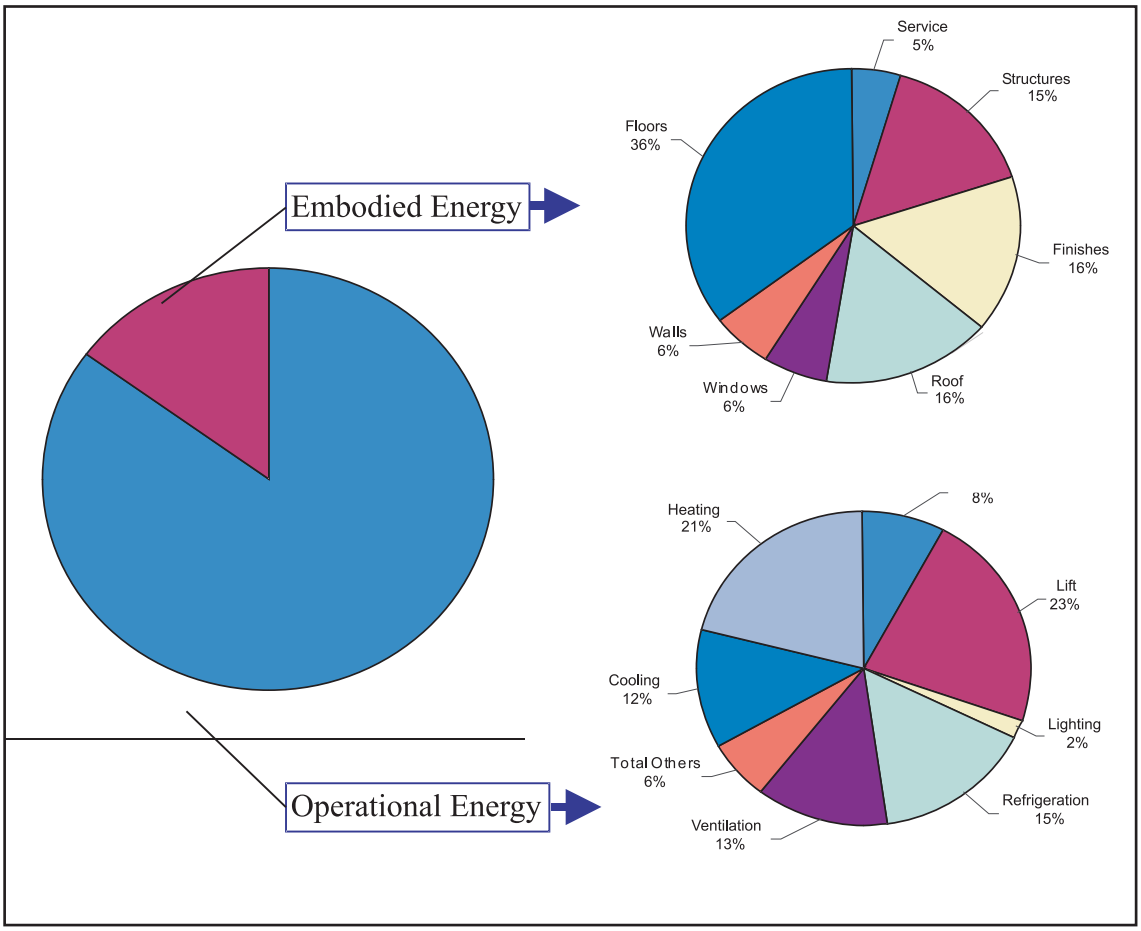

Figure 2: Energy consumption of a typical building over 60 years of life

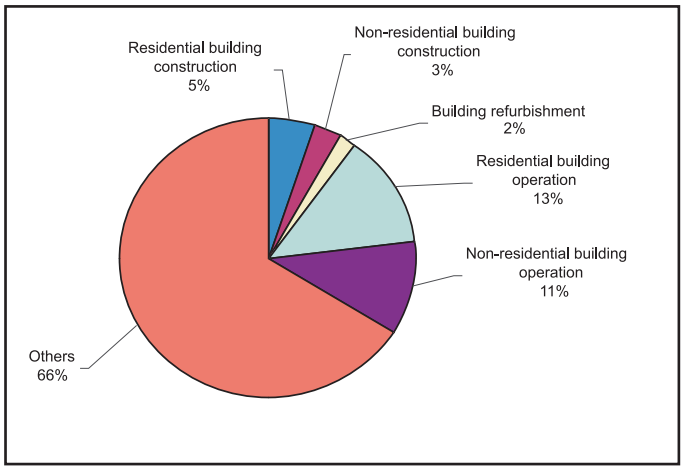

Figure 3: Breakdown of CO_2 Emissions, Japan (1995)

Economic benefits

- Reduce operating costs
- Improve occupant productivity
- Optimize life-cycle economic performance

Social benefits

- Enhance occupant comfort and health
- Minimize strain on local infrastructure
- Improve overall quality of life

As the need for sustainable design becomes more evident, architects are beginning to realize that the impact and influence of their work reach far beyond the exterior walls of their buildings. When the guidelines and principles of sustainable design are reviewed, and organized into a set of sustainable design components, it becomes evident that opportunities for creating communities and buildings that are not primarily dependent on fossil fuel burning power grids should be explored. These developments

could depend on grids derived from renewable energy plants and individual renewable energy systems such as photovoltaics (PVs) and solar hot water systems. A large number of built examples in many countries of the world clearly and amply demonstrate that this is achievable in many cases.

Opportunities for creating communities and buildings that are not primarily dependent on fossil fuel burning power grids should be explored. These developments could depend on grids derived from renewable energy plants and individual renewable energy systems such as photovoltaics (PVs). Theoretically, this is achievable, however, in most cases it is still not feasible. The building and/or development site should be analyzed for its renewable energy resources. The natural features and elements on sites often contain some potential for renewable energy uses.

Solar energy is developing on two scales, the large scale deals with solar power plants. The small scale involves PVs and solar air and water heating for individual buildings. Some examples of large scale applications include the use of hydro-electric power in the Great Lakes region, taking advantage of Niagara Falls. Wind power, used extensively in some regions of California takes advantage of the prevalent winds in those areas. Large areas which are unattractive for development, such as deserts, are ideal places for solar or wind power plants.

The greatest advantages of solar power are its cleanliness and its availability to all regions. Photovoltaics also have great economic advantages for buildings or communities located in rural sites, where the cost of extending one mile of power line in going "off grid" with PVs may be the best economic option. With current technologies in place, other renewable sources of energy such as hydro-electricity, electricity from geothermal, and biogas fuel produced from solid waste, are also able to provide enough electricity for a small community.

Internationally, solar water heating is expanding rapidly in countries that have offered subsidies, have less-developed energy infrastructure, or both. SWH systems have achieved significant installation rates in countries as diverse as Israel, Turkey, and China.

Solar Water Heating: Success Around the World

The energy conservation, environmental, and national security benefits of solar water heaters are recognized and appreciated around the world, as shown in the following table:

	Glazed solar thermal area installed in 1999	% of Total
China	4, 000, 000	43.3
India	2, 000, 000	21.6
Japan	1, 000, 000	10.8
Europe	890, 000	9.6
South Korea	500, 000	5.4
Turkey	430, 000	4.7
Israel	400, 000	4.3
USA	25, 000	0.3

Emerging economies such as China and India rely on solar water heaters to free up valuable electricity and fossil fuels for more productive commercial and industrial uses, while still meeting the demands of their growing economies. Nations with geographically or politically constrained access to energy (e.g., Japan, Israel) consider solar water heaters as integral components of their energy or national security policies. European consumers and nations appreciate the environmental benefits conferred by solar water heaters.[3]

The benefits of solar water heaters are recognized and appreciated around the world, as shown in the table above.

PHOTOVOLTAICS ON BUILDINGS

Unlike any other known form of electricity production, photovoltaics (or PV) has no moving parts, is noiseless, produces no emissions during use and is completely scaleable from very small to very large electrical generators in a totally modular way. It is therefore the only form of electrical energy generation that has the potential to be placed at the far end of the electricity distribution chain.

Photovoltaics used in buildings have many economical benefits. Mounting photovoltaics on buildings means that no additional costs are spent on land to instal the solar generators. In some cases, photovoltaics can replace some of the building materials that would otherwise be used, and then the true cost of the photovoltaic system can be thought of as the difference between the full photovoltaic system price and that of the replaced building material. Nearly all photovoltaics in buildings (PVIB) systems are grid-connected. The dc electricity from the photovoltaic array is converted into mains compatible ac by a special inverter, and the ac electricity is fed into the building's main electricity supply. Any excess not used within the building is exported to the electrical supply network (grid). As the electricity is generated where it is consumed,

transmission and distribution losses are avoided, which reduces the utility's capital and maintenance costs.

In most grid-connected photovoltaic domestic houses, the solar energy is generated in the daytime and the excess is sold to the grid. At night, when the house demand is usually highest, electricity is bought back from the grid. The electricity generated by a grid-connected photovoltaic commercial building can nearly always be used by the building itself (peak load is in the daytime). There is no need to sell excess electricity to the grid, because there is no excess. The value of the photovoltaic-generated electricity is equal to the avoided cost per kWh of the grid electricity that is saved (i.e. higher than the normal buying price of a utility).

Photovoltaic systems are environmentally-friendly. Modern architecture increasingly attempts to combine aesthetic, ecological and technical issues. Architecturally well-executed and integrated photovoltaic systems lend themselves ideally for this purpose. The designs are easily accepted by design professionals, building owners and the general public. They can also give added value to the solar power system by, for example, improving a company's corporate image. The greatest challenge to all energy production is its impact on the environment. Solar power is one of the friendliest ways of producing electricity. In grid-connected systems, its use has absolutely no effect on the environment, because the systems do not even include batteries that would need to be replaced.

The White Paper "Renewable energy future for the developing world" released by ISES (International Solar Energy Society) further stresses these points[3]:

"Using renewable energy and energy efficiency in buildings is techno-economically feasible, and significantly cheaper than building new power stations. New glazing and insulation materials are entering the market. Daylighting produces less unwanted internal heat than most electric lighting. The unwanted reject heat of inefficient appliances and machines like printers and photocopiers has to be removed by air conditioners in office buildings in warm climates. Town planning and integrated resource planning with renewable energy systems and devices offer great opportunities, especially in countries with underdeveloped infrastructures."

The economic and environmental benefits of using the common renewable Solar systems in built environment are mentioned below[4].

ECONOMIC BENEFITS

Provides superior lighting at least cost: Solar home systems provide the least-cost means of receiving high quality home lighting as well as access to radio and television. When low-cost financing is available, monthly payments for a solar home system are often below what a family is currently paying for kerosene, dry-cell batteries, candles, and recharging car batteries.

Extends the productive workday: It is dark by 6:30 year round in the equatorial latitudes. Electric lighting allows families to extend their workday into the evening hours. Many villages where solar lights are installed now boast home craft industries. In Vietnam, solar outdoor lights installed in two village markets allows businesses to operate during the evening.

Fosters micro-enterprise development: Solar electricity helps promote local enterprises. Small shops and village markets can use the systems to provide lighting to operate during the evening. Small businesses utilizing electric sewing machines, water pumps, and computers are also benefited by the availability of solar electric systems.

Creates direct employment opportunities: Local businesses selling and servicing solar home systems provide employment for local residents. Dealers, technicians, and local technicians all can be employed selling and servicing solar home systems.

Facilitates development of micro-lending programs: Revolving credit funds, and other financing mechanisms may be utilized for the purpose of

3. http://www.whitepaper.ises.org

4. http://www.self.org

purchasing solar home systems. Such credit funds serve as a vehicle for local financial institutions to begin loaning money to rural areas.

In addition, there are following educational and health benefits of renewable energy use.

EDUCATIONAL BENEFITS

Improves literacy: Solar rural electrification improves literacy by providing high quality electric reading lights. Electric lighting is far brighter than kerosene lighting or candles. Use of solar electric light aids students in studying during evening hours.

Increases access to news and information: Photovoltaics give rural areas access to news and educational programming through television and radio broadcasts. With the advent of television and radio, people previously cut off from electronic information, education, and entertainment can become part of the modern world without leaving home.

Enables evening education classes: Ongoing education classes and adult literacy classes can be held during the evening in solar-lit community centers. Development of adult literacy and professional classes are possible with the introduction of solar electric lighting systems in community centers and schools in many countries.

Facilitates wireless rural telephony: Solar electricity, when coupled with wireless communications, makes it possible to introduce rural telephony and data communication services to remote villages.

HEALTH BENEFITS

Reduces kerosene-induced fires: Kerosene lamps are a serious fire hazard in the developing world, killing and maiming tens of thousands of people each year. Kerosene, diesel fuel and gasoline stored for lamps and small generators are also a safety threat, whereas solar electric light is entirely safe.

Improves indoor air quality: Fumes from kerosene lamps in poorly ventilated houses are a serious health problem in much of the world where electric light is unavailable. The World Bank estimates that 780 million women and children breathing kerosene fumes inhale the equivalent of smoke from 2 packs of cigarettes a day.

Increases effectiveness of health programs: Use of solar electric lighting systems by rural health centers increases the quality of health care provided. Solar electric systems improve patient diagnoses through brighter task lighting and use of electrically-lit microscopes. Photovoltaics can also power televisions and VCRs to educate health workers and patients about preventative care, medical procedures, and other health care provisions. Finally, solar electric refrigerators have a higher degree of temperature control than kerosene units, leading to lower vaccine spoilage rates, and increased immunization effectiveness.

Allows telemedicine: Telemedicine is the use of telecommunications technology to provide, enhance, or expedite health care services, by accessing off-site databases, linking clinics or physicians' offices to central hospitals, or transmitting x-rays or other diagnostic images for examination at another site. Feasibility of telemedicine in remote areas has been demonstrated by using a combination of solar power and satellite communications in the Brazilian Amazon. Within moments of plugging in the new telemedicine device, local Caboclo Indians could have measurements of blood pressure, body temperature, pulse, and blood-oxygen uploaded via satellite to the University of Southern Alabama for remote diagnosis. ❑

Improper selection of pumps can lead to large wastage of energy. A pump with 85 per cent efficiency at rated flow may have only 65 per cent efficiency at half the flow.

SOCIO-ECONOMIC & ENVIRONMENTAL IMPACT OF WIND ENERGY GENERATION IN SELECT DISTRICTS OF TAMILNADU

J. Srikanth *

OBJECTIVES

(i) To find out the positive impact of wind energy generation on employment opportunities, economic development, infrastructure developments such as educational institutions, health care facilities, entertainment facilities, hostels and restaurants, road and transportation facilities and communication facilities in the villages where the wind farms are located in Coimbatore, Tirunelveli and Kanyakumari districts of Tamil Nadu.

(ii} To study the negative impact such as noise pollution, accident due to wind farms, increase of criminal offences, felling of trees, use of agricultural land for wind farms, wind farms near dwelling places etc., due to wind energy generation in the villages where the wind farms are located in Coimbatore, Tirunelveli and Kanyakumari districts of Tamil Nadu.

(iii) To analyse the operational issues such as use of wind farms for cultivation on, Grid and substation facilities for power evacuation, and maintenance operational constraints financial performance and investment and loan repayment status of the wind farm owners located in Coimbatore, Tirunelveli and Kanyakumari districts of Tamil Nadu.

FINDINGS

Positive Impact due to wind farm activity

Employment opportunities after erection and commissioning.

Local villagers are selected as operators and security guards. The operators and security guards are employed either directly by the company or through the service providers such as Batliboi Foras Limited, R S Windtech Pvt. Limited, Victory Wind Farm Services Pvt. Limited, Windfab Pvt. Limited etc. For the operators job, ITI or school final qualified persons are employed and for security guards educational qualification is not given much importance. The salary for the operators is in the range of Rs.1500 - Rs.4000 depending on the company and the salary for the security guards is in the range of Rs.1000 - Rs.2000, again depending on the company and the location.

Based on the survey and our discussions with various people and agencies, we estimate that around 4000 - 5000 persons are employed as operators in the wind farms in Coimbatore, Tirunelveli and Kanyakumari districts of Tamil Nadu and another 3000 - 4000 persons as security guards. This employment potential offered by the industry is very less, considering the investment (approximately Rs.3000 crore in Tamil Nadu alone) that has been made. This is the nature of the industry - more capital intensive and less labour intensive.

Employment opportunities for erection and commissioning

Local people are employed for civil, welding and electrical works for 3 months about 50 persons at the time of erection and commissioning of the WEG. This employment is temporary in nature. Now, with the slow down in new projects due to TNEB's unfavourable policies, this employment potential has come down drastically in Tamil Nadu.

Remunerative land price

Except in Kayathar, in places like Ithikulam, where land has been sold for as low as Rs.500 per acre, in all other places, the mostly barren land has been sold for high prices. In locations like Muppandal and Aralvoimozhi villagers have sold their lands for

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as high as Rs.10 lakh per acre. Now, in this site land is sold for wind farm activity in points (1 points = 60 cents / 0.6 acre). People say brokers have made a fortune in the sale of land for wind farm activity. In few cases, again in Muppandal and Aralvoimozhi, lands used for agricultural purposes have been converted into wind farms and in few cases, there have been instances of felling of trees.

power supply

In many villages where the wind farms are set up; people have told us that they either get 24 hours continuous power supply or improved power supply due to wind farm activity. This power is helpful to the villagers for doing other businesses such as power loom, mat industry, Poultry farms etc. apart from using this power for agricultural purpose.

Infrastructure development

Not many wind farm owners have contributed to infrastructure development. The following are few examples, where some progressive wind farm developers have helped in infrastructure development of the local community

(a) Wescare - Das Lagerwey : This company has set up a community hospital. Amirtham community hospital at T. Karungulam.

(b) Arul Mariamman Textiles Limited (AMTL): This company has constructed a bus shelter in association with Lions Club, in Aralvoimozhi

Donations to festivals and temples

Many wind farm developers have donated liberally to local festivals and temples. Some of them have helped in construction or renovation of temples. For example Fenner (I) Limited has donated a temple arch in Aralvoimozhi. Some wind farm developers have built their own temples (mostly Hanuman Temple) in their wind farms.

Negative impact of wind farm

Even though the surveys have shown no major negative impact due to wind farm activity, some have mentioned (proportion is less) about few negative impact due to wind farms.

Sound Pollution

The survey has shown sound pollution as a major negative impact. About 19.25% of the respondents have said wind farm activity leads to sound pollution. Many people, out of these 19.25% have said in the nights the sound is very disturbing. The other 80% of the respondents have told us even though, there is some slight noise it is tolerable. When we visited personally some of the sites, we found the variable speed twin blade Das Lagerwey WEGs to be bit more noisy and at high speed disturbing.

Felling of trees

There have been few instances of felling of trees. Our survey shows only 2.5% of the respondents confirming felling of trees. This should be avoided.

Use of agricultural land for wind farms

There have been few instances where agricultural land has been converted into wind farms. This has occurred very rarely. Only 0.25% of the respondents confirmed this negative impact. This again should be avoided.

Wind farms near dwelling places

Even though this has not come out as a serious negative impact in the survey the researchers have found WEGs very close to dwelling places in Muppandal, Aralvoimozhi, Kumarapuram, Pazhavoor. and T. Karunkulam. This should be stopped.

Operational and Financial Performance of Wind Farms

(i) NEPC - MICON and Vestas RRB are the top two WEGs in that order that have been installed by the wind farm owners.

(ii) 75%, 43.75% and 18.75% of the respondents have installed 250 KW, 225 KW and 230 KW capacities WEGs respectively. Of late, the wind farm owners

are installing higher capacity WEGs. We came to know through discussions with wind farm owners that Dalmia Cements Limited has installed 2 numbers of 750 KW WEGs at Kumarapuram.

(iii) Very few wind farm owners have taken up cultivation in their Wind farms. Even those who have purchased agricultural land (3 respondents) only one is using it as agricultural land and the other 2 are using it as partly agricultural land. The survey of wind farm owners have clearly indicated that only 3 out of 16 respondents are doing cultivation in their wind farms. Out of these 3, 2 of them are in Muppandal, Aralvoimozhi and Perungudi region and one of them is located in Devarkulam in Kayathar region.

The survey has also shown that wind farms in Coimbatore district are not doing cultivation and they are keeping their predominantly barren land as barren after the installation of WEGs. We have come across only one wind farm owner, Dr. Ganapathy of Sheela Clinic, Coimbatore doing cultivation (Cashew and horticultural crops) in Coimbatore district.

{iv} The main crops that are cultivated by the wind farm owners are, Mango, Guava, Ground nut, Drumstick, Amla, Cashew and Eucaplyptus. Most of them use drip irrigation for growing these crops. The wind farm owners who are doing cultivation are Fenner (I) Limited, Madras Cements Limited, Dalmia Cements Limited, Tamil Nadu Newsprints Limited (TNPL) and Sheela Clinic.

(v) Because of the remote locations of the wind farms, even the wind farm owners who have in-house maintenance capability are giving their maintenance work, to OEMs of WEGs or third partly service providers such as Batliboi Foras Limited, R S Windtech Engineers Pvt. Limited, Victory wind farm Services Pvt. Limited etc. Our survey has shown that 43.75% of the respondents have given maintenance of their wind farms to WEG manufacturers under Annual Maintenance contract (AMC), another 43.75% of the respondents have given the maintenance of their Wind farms to third party maintenance service providers and only 12.50% of the respondents are carrying out in-house maintenance. In fact, most of the wind farm owners give the operations of their wind farms to OEMs or to third party service providers.

(vi) The wind farm owners are not facing any problem in the availability of spares. In fact, 100% of the respondents have felt that there is no problem in the availability of spares. Almost a11 the spares are available within the country. While all the respondents (100%) have bought their spares from the WEG manufacturers, in the initial years of establishment, currently 68.75% of them buy their spares from the WEGs manufacturers, another 68.75% of them buy their spares from spares suppliers/distributors, 31.25% of them buy from third party O & M service providers and only 12.50% of the respondents import some of their spares.

(vii) 93.75% of the wind farm owners surveyed have obtained the soft loan provided by IREDA and 56.25% of them have obtained loan from other financial institutions. Thus, all the 16 wind farm owners who have been surveyed have taken loans for their wind farm projects. Also, out of the total project cost of all the 16 Wind farm owners which is Rs.3,014.97 lac, loan obtained from IREDA alone is Rs.11,132.815 lac that is 36.87% of the total project cost. This clearly shows the pioneering, and dominant role played by IREDA in promoting and developing wind energy in India.

(viii) In the three financial years considered viz., 1997-98, 1998-99 and 1999-2000, the profitability of the wind farms have steadily improved. Our survey has shown that 83.33% and 85.71% of the respondents have declared net profit in the financial year 1997-98, 1998-99 and 1999-2000 respectively. 85.72% of the respondents have made profits and this shows the commercial attractiveness of the wind farm projects

Our survey has shown that all the wind farms that used the power generated for captive power consumption have made net profit. This is because selling to TNEB fetches only Rs.2.70 per unit and captive use fetches Rs.3.40 per unit (this is the selling price per unit of TNEB to industrial consumers). With delays in payment from TNEB for the power sold to them and third party sale not being allowed in Tamil Nadu captive power consumption is the best

proposition for higher profits for the wind owners in Tamil Nadu.

SUGGESTIONS

1. Wind farm activity has only benefited a small proportion of the local community and it is not widespread. To broad base the beneficiaries and to involve and help the local community, the following suggestions are given:

- Start farming activity in the wind farms wherever possible. Experts say any crop upto five meters can be grown without affecting the wind farm activity. This will lead to incremental profits to the wind farm owners. In addition we can help a higher proportion of the local people.
- Cattle grazing by the villagers should be allowed on the wind farms.
- In Muppandal/Aralvoimozhi, a suitable site can be selected and it can be developed into a beautiful tourist spot. With Kanyakumari nearby, it can be made an attractive tourist destination.
- Major wind farm developers and captive users such as Dalmia Cements, Madras Cements, Mohan Breweries, etc. should be made to contribute more to the local community.
- Some form of local tax, may be nominal per WEG, can be levied by the local bodies and this amount can be used by them for the infrastructure development of the locality.

2. A uniform and long term wind energy policy by MNES is very essential for the continued growth of this industry. Different States have different policies for wheeling, banking, penalty for reactive power and third party sale, which should be made unform. TNEB policies announced in February 2001 has crippled this industry in Tamilnadu. TNEB policies that are detrimental to the growth of this industry are

a. TNEB is willing to pay only Rs.2.25 per unit for the power sold to TNEB by new wind farm owners started after February 2001. The already existing wind farms will continue to get Rs.2.70 per unit. The price that is offered to new wind farms is quite low, considering the fact that this price Rs.2.25 was offered in the year 1995-96 itself to the already existing wind farms. Hence the price per unit offered to new wind farms is not only very low but also discriminatory. Also, the price Rs.2.70 per unit offered by TNEB to already existing wind farms is less compared to the price of Rs.3.05 offered by SEB of Karnataka. Thus, the price of Rs.3.05 per unit asked by Wind Power Producers Association (WINDPRO) is justified.

b. TNEB discourages new projects which intend selling power to TNEB. The issuing of NOCs for such cases are delayed. NOCs are given to new wind farm projects that intend using the power generated for captive consumption.

c. Banking facility which was allowed earlier for 12 months has been reduced to one month now.

d. Hike in the penalty for reactive power consumed by the wind farms from the earlier Rs.0.30 per KVARh to the Rs.1.00 per KVARh. This was challenged in the court by WINDPRO and the court through its interim order has asked the wind farm owners Rs.0.50 per KVARh.

e. No third party sale allowed in Tamilnadu

f. Holding back payments due to the wind farm owners since August 2000.

The Tamilnadu state government should announce favourable policies, if it wants to retain its status as number one state in wind energy generation in the country

3. Removal of gearbox/generator from the top of the tower for maintenance purposes requires heavy mobile crane. Availability of such cranes on hire basis through some third party service providers will minimize the loss of power generation due to maintenance and cost of maintenance.

4. Common spares facility can be provided at Muppandal/Aralvoimozhi, Kayathar, Gudimangalam /Poolavadi and Kethanur/Palladam by WINDPRO or any other Association. This will facilitate the easy availability of spares and minimize spares/inventory costs. for the wind farm owners

This report is the Executive Summary of the findings of an IREDA study conducted in the year 2003

ENVIRONMENTAL AND SOCIAL IMPACTS OF RENEWABLE ENERGY – INDIAN EXPERIENCE

Mahesh Vipradas*

INTRODUCTION

India has a very large potential of renewable energy. It is estimated that wind, small hydro and biomass sources alone, have potential of generating 80,000 MW of electricity. In addition, there is a large potential for decentralised applications of renewable energy. The renewable energy sources are locally available and can meet different types of decentralised energy requirements form irrigation, & cooking to power generation even in rural areas. It is also clear that though renewables alone may not be able to meet all the energy requirements, they can make substantial contribution and reduce the pressure fossil fuels. India has a long experience of almost two decades in developing and deploying renewable energy technologies. Some of the renewable energy technologies are now commercially viable and can compete with other energy sources. However it is always perceived that the renewable energy technologies are costlier than the technologies which use conventional fossil fuels. The use of renewable energy sources also provides environmental and social benefits in addition to providing energy. These additional benefits are not considered while comparing renewables with other technologies. It is also true that quantification of these benefits is difficult as well as dependent on local/ regional conditions. The literature available internationally, mainly regarding power generation, indicates that these environmental benefits of renewables are substantial. The present article looks at the environmental and social impacts of renewables in India.

ENVIRONMENTAL IMPACTS

Use of renewable energy for different applications results in reduced consumption of conventional energy sources which are mainly fossil fuels like coal, oil, traditional biomass etc. The combustion of these fuels results in emissions, which have impact on local as well as global environment. These negative environmental impacts are reduced through use of renewable energy to extent of replacement of conventional fuels. The important environmental impacts of fossil fuel combustion are

- emissions of CO_2, CO, SOx, NOx, particulate matter; and
- land and water pollution as a result of fuel storage, use and waste disposal.

Combustion of fuels like coal, oil, natural gas as well as traditional use of biomass results in these emissions in different quantities depending upon the fuel and the combustion technology. Except the CO_2 emissions, the rest of the emissions have an impact on local environment and in turn have an adverse impact on human health, ecology, agriculture etc. These adverse impacts on human heath and ecology have economic implications and the cost estimation of conventional energy does not include the economic cost of these environmental impacts and thus these impacts are termed as 'externalities'.

In case of India the scale of renewable energy applications is very diverse from producing grid quality power to improved chulha. These diverse applications of renewable energy results in reduce usage in use of conventional fuels in varying quantities, depending upon the renewable energy application. Estimation of environmental implications of all these renewable energy sources and the different applications is very complex. The major application of power generation is selected here for detailed analysis of environmental impacts, since relevant data and literature were available.

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ENVIRONMENTAL BENEFITS OF RENEWABLE POWER GENERATION

Wind, Biomass, small hydro and waste to energy are the main renewable energy sources contributing to grid power in India. The total installed capacity, based on renewable energy sources as on 31st March 2005 was 6156MW *(1)* generating about 3% of total power generation in India. The resultant environmental impact is through reduction in the conventional power generation and related environmental emissions.

The conventional power generation in India is predominantly dependent on thermal power plants followed by hydro and other sources. The generation break-up for the year 2004-05 is given in **Table 1**.

The thermal power generation that is primarily coal–based in case of India, causes major environmental pollution. The actual emissions from the coal–based power plant can be estimated by using the emission norms, specified through the Environment (Protection) Act, 1986 and its amendments which provide norms for allowable levels of emissions form conventional power plants. The estimated emissions as a result of power generation from the coal–based power plants are given in **Table 2**.

The main emission from a gas–based power plant is NOx. Based on the emission norm of permitted emissions and the design heat rate for combines cycle gas power plants, the NOx emissions from a gas–based power plants are about 0.016 g/kWh. Similarly the CO_2 emission from combined cycle power plant are about 0.48 kg/kWh.

Based on the emission factors estimated above, and the contribution from different sources (**Table 1**) the average emissions as a result of power generation in India, are given in **Table 3**.

All the above emission estimations are conservative, using environmental norms and an approximation using national average efficiency of thermal power plants.

The power generation from wind, small hydro as well as biomass is resource dependent and varies

TABLE1: POWER GENERATION FROM DIFFERENT SOURCES IN THE YEAR 2004-05

Fuel/Source	Generation (GWh)	Generation %
Coal	424082	72
Gas	59473	10
Diesel	2518	0.4
Hydro	84495	14
Nuclear	16845	3
Total	**587413**	**100**

Source: Monthly Power Sector Report, Central Electricity Authority

TABLE 2: EMISSIONS FROM COAL BASED POWER PLANT

Coal	Norm ppm 1 (a)	Coal use kg/kwh (b)	Flue gas volume 3 (c)	Flue gas (kg/kwh) d=b*c	Emissions (kg/unit) ($e=d*a/10^{-6}$)
Particulate matter	150	0.73	7.24	5.2852	0.000793
SOx	200	0.73	7.24	5.2852	0.001057
NOx	100	0.73	7.24	5.2852	0.000529
CO_2		2782[4]			1.10^5

1-As per the Environment (Protection) Act, 1986

2-Thermal Performance Review, Central Electricity Authority

3-Based on energy audits of different thermal power plants, TERI

4-All India average heat rate in coal based power plants

Based on average calorific value of 4000Kcal/kg and IPCC emissions factor of 25.8 tC/TJ

TABLE 3: AVERAGE EMISSION FROM GENERATION OF ONE UNIT OF POWER

Emission	Kg/kWh
Particulate matter	0.000563
SOx	0.00075
NOx	0.000377
CO_2	0.828635

from location to location. The total annual generation thus has been estimated with average plant load factors for these technologies as shown in **Table 4**. Based on the emission factors and the generation from different renewable energy sources the total annual emission reduction is estimated and given in **Table 4**.

In addition to these emissions, there are ash handling issues, local land and water pollution associated with thermal, mainly coal–based, power generation.

All these emissions, land, water and noise pollution affects the local environment having impact on human health and eco system. The quantum of economic impact of these depends on large number of factors like willingness to pay for health, adverse ecological impacts, income levels, extent of the impacts etc. The *ExternE Study* undertaken by the European Commission *(2)* considers damages to human health (fatal and non-fatal effects), and effects on crops and materials. The ExternE study gives estimates for coal, oil, natural gas and biomass fuel cycles as follows (in USD 95 per kWh,)

TABLE 5: RANGE OF ENVIRONMENTAL IMPACT OF POWER GENERATION

Power generation source	Environmental impact range (US$2005)
Coal -fired	0.061 – 0.0029
Oil-fired	0.036 – 0.0016
Natural gas-fired	0.014 – 0.0025

Coal -fired	$ 0.046
Oil-fired	$ 0.027
Natural gas-fired	$ 0.011
Biomass	$ 0.0012 - $ 0.012

In the New York State Environmental Externalities Cost Study *(3)*, also estimates the environmental cost of conventional power generation. It also includes the environmental cost of biomass power generation. As per these estimates the environmental costs as a result of power generation are:

Coal–fired	$ 0.0020 - $ 0.0032
Oil–fired	$ 0.0011 - $ 0.0016
Natural gas–fired	$0.00017 - $0.00024
Biomass (wood)	$ 0.0025 - $ 0.0036

Using these two studies a range of environmental cost of conventional power generation can be estimated as shown in **Table 5** below. The US$ (1992) and US$ (1995) were adjusted to US$ (2005)

TABLE 4: ANNUAL EMISSION REDUCTION AS A RESULT OF RENEWABLE POWER GENERATION IN INDIA

	Installed capacity (MW)	Average capacity factor	Annual generation (GWh)	Annual emission reduction (ton/annum)			
				SPM	SOx	NOx	CO_2
Wind	3595	25%	7873.05	4431.914	5907.356	2969.013	6523884
Biomass	815	70%	4997.58	—	3749.816	—	3107228
Small Hydro	1705	35%	5227.53	2942.693	2207.98	832.6531	689965.4
Total	6115		18098.16	7374.607	11865.15	3801.666	10321077

by using average annual inflation in US$ of 3%.

Adopting the approach of "income elasticity of Willingness to Pay" which look at relative GDP per capita is calculated for India in the following manner:

$WTP_{India} = WTP_{US} \times PERCAP\text{-}GDP\ (PPP)_{India} / PERCAP\text{-}GDP(PPP)_{US}$

If GDP per capita $(PPP)_{India}$ = USD 3400 and

GDP per capita $(PPP)_{US}$ = USD 42000

Then the ratio between $WTP_{India}/WTP_{US} = 0.08$

The environmental impacts given in **Table 5** can be adjusted to India, using the ratio of willingness to pay, estimated above and given in **Table 6** below. The above estimated environmental impact does not include the environmental cost of CO_2 emissions. The impact of CO_2 emissions, through global warming, is a complex issue and difficult to quantify. However, there is an established trading system for CO_2 emission reduction and these costs can be used in absence of quantification of cost of impacts. A conservative estimate of CO_2 costs of $4/ton of CO_2 has been used for estimation here. Thus the total environmental cost from a conventional power generation works out as shown in **Table 6**.

Alternate way of looking at the environmental impacts of renewables is to estimate the cost of emission reductions at the conventional power plants. The cost calculation in a study carried out The Energy and Resources Institute *(4)* considered costs involved to reduce the environmental pollution and other impacts of thermal power generation. The categories considered in the study are

Air pollution control

Electrostatic precipitators for reducing particulate matter

Desulpurisation unit for reducing SOx emissions

Water pollution control

Water treatment facility,

Condensate cooling water, Demineralisation plant and waste treatment

Ash disposal

Ash handling systems, Ash Dykes

Forest

Afforestration, Green belt development

The results of the study shows that incorporation of forest area and cost of ash dyke construction can change the total environmental cost from 12 to 25% of total cost for the same plant size. The cost rises further to 27% of total cost for adherence to the World Bank norms, which involves only an additional expenditure on electrostatic precipitator. The average (all India) total environmental costs range from Rs.0.42/kWh to Rs.0.87/kWh.

Thus the environmental impacts of renewables, though estimated in an indirect way, are substantially high in the case of India and range from 0.20 Rs/kWh to 0.87Rs/kWh for power generation. In addition to power generation, there are a large number of renewable energy systems deployed in

TABLE 6 ENVIRONMENTAL EXTERNALITIES OF FUELS IN INDIA

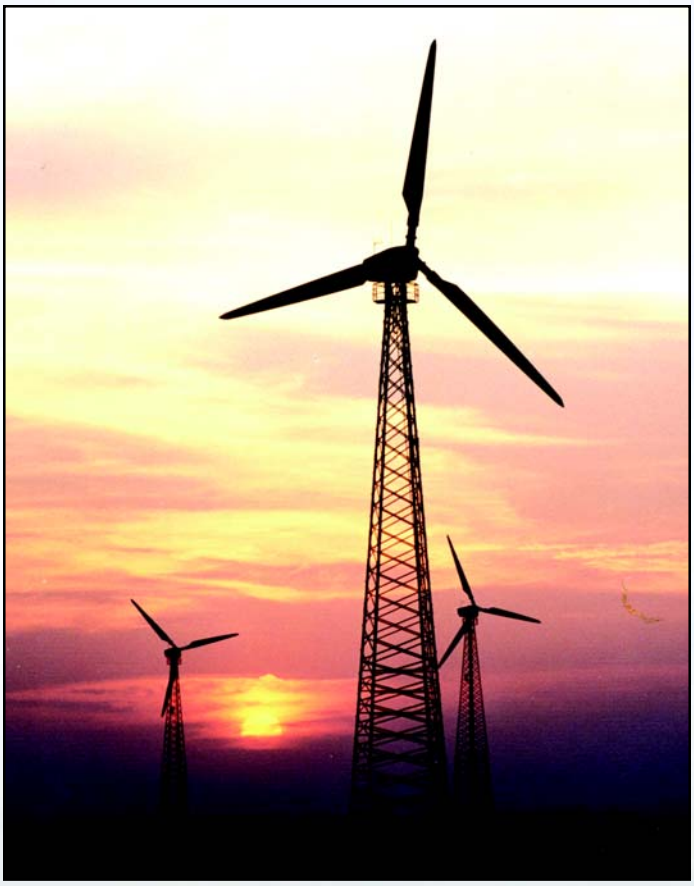
Fuel	Range of environmental cost (Rs./kWh)	Cost of CO_2 @US$4/ton of CO_2 range(Rs/kWh)	Total environmental cost environmental cost (Rs/kWh)
Coal	0.22 - 0.01	0.19	0.42 - 0.20
Gas	0.05 – 0.001	0.08	0.13 – 0.08

Exchange rate used 1US$ = 45 INR

installation, and finally operations & maintenance services. This allows us to offer Indian customers the economies of scale and also eliminating the need for customers to get involved in the highly complex process of windfarm development.

This end-to-end approach has led us, with our associate companies, to develop an expertise in wind resource mapping, site identification and selection, and technical planning of wind power projects. Our associate companies acquire sites we have identified as suitable for wind energy projects, which are then sold or leased to our customers. The associate companies then undertake the technical implementation of windfarms including infrastructure development, installation of WTGs and connection of power grids.

Some of our largest projects executed till date are - Sangneri, Tamil Nadu: This windfarm has a planned capacity of upto 500 MW and is home to 276 WTGs totaling 339 MW of installed capacity, making it the largest windfarm of its kind in Asia. And,



Vankusavade, Maharashtra: Stretched over 29 km of mountainous terrain averaging over 1,000 meters above sea level, this windfarm is home to 566 WTGs with an installed capacity of 205.35 MW. Other sites include Kavadya Dongar in Maharashtra and Chitradurga in Karnataka. We are in the process of developing other windfarms in the States of Gujarat, Kerala, Karnataka and others.

SEL will strive to enhance its position in India as a provider of integrated wind power solutions and to expand our market globally. However, the strategic focus of our activities will be on the Indian market.

In order to increase our global market share, we will focus on our key international markets North America, China, Australia and certain markets in Europe. Looking to the global market, SEL has its international marketing headquarters in Denmark, the preeminent centre for wind energy in the world. Plans for an integrated WTG manufacturing facility in China are in an advanced stage, and the rotor blade manufacturing facility in the United States is also under construction. These will support our market presence in these high growth regions with dedicated delivery capability, enabling a flexible response to the local markets, and lowered logistics costs.

SEL is currently in the final stages of executing orders totaling 80 MW for windfarm projects in USA, and has secured major repeat orders in this market. We have secured breakthrough orders in emerging high-potential markets - 95 MW in Australia, 100 MW in China and 14 MW in South Korea. Suzlon has also recently acquired Hansen Transmissions, a Belgium-based wind and industrial gearbox manufacturer in line with our long-term growth strategy. Our expanding global footprint is a clear indicator of international recognition of our technological leadership, domain expertise and delivery capability.

Looking to the future in India and around the world, we believe our core strengths make strongly competitive in the marketplace. We aim to improve the cost efficiency of generating power from our WTGs through more efficient designs, identifying further optimal sites for WTGs, and reducing costs across-the-board.

Disclaimer: Data contained in this document is accurate as on the date of publication.

ADVERTORIAL

Coming of Age: Powering Renewables With Public Awareness

India has come a long way with in the arena of renewable power - from a few Megawatts from all renewable sources just a decade ago, the country has grown to an installed capacity of 4,500 MW in wind alone, and powered its way into the Top-5 countries in terms of annual capacity addition, with over 1,200 MW installed in 2005 alone.

However, despite the breathtaking and steadily accelerating pace of investment and development in renewables in India, the drivers for its growth have remained limited. Investments in renewables in India have traditionally been driven by two factors – the ever increasing power needs of the country's burgeoning economy; and favorable government policies. While these two drivers will continue to be the most crucial drivers for growth in renewables in India, there is today an emerging opportunity to cultivate a new and potent driver, capable of propelling renewables to the same platform as conventional sources of energy – **Public Awareness**.

Today, there remains a considerable lack of awareness of renewable energy - industry, potential, issues, et al. in the general populace. While the main stream media picks up on relevant industry developments, socio-economic & environmental factors, new technology and trends; there are few or no concerted efforts directed at informing and directing public opinion in this regard.

For a major part this trend is a direct reflection of the age of the industry in India – while the industry has grown in leaps and bounds to catch up with global leaders, the general populace and media outlets have not had the time and exposure, in comparison with mainly Western counterparts, to the renewables arena.

However, while this can be said to be the case in the past – the booming Indian economy, proliferation and penetration of mass media and the transformation of common people from opinion seekers to opinion leaders, has transformed a new force capable of propelling renewables in India to a new high.

While this is a new direction in India, there is a multitude of ongoing and past efforts by industry, agencies and governmental and other bodies worldwide that can provide lessons and direction in the Indian context. The time is right for a concerted effort across industry, agencies and other stakeholders to mobilize public opinion towards bringing the renewable energy industry in India into the mainstream.

While there are many forums and independent bodies operating in the arena, it is becoming increasingly necessary to forge a common platform that can become a meeting place for various lines of thought.

The audience for such an endeavor ranges from the common man to the policymakers who are uninformed about renewables and areas that impact the field. In such light there requires to be fact finding at the basic level to determine current levels of awareness on the various aspects of renewable energy and how it can affect people's lives.

Using such data, subject areas could be identified. Based on informal surveys, subjects are seen to cover a vast area, ranging from pollution, climate change, increasing cost and decreasing stocks of conventional fuels, economic impact in terms of industrial production, to power generated and jobs created, environmental impact of wind turbines, emission reductions achieved, energy payback etc; to consumer oriented subjects focused around availability and affordability of power.

Power is a common thread through communities. Regardless of geography, culture, and other differentiators, the functioning and development of communities of all sizes is crucially linked to the availability of power. In essence each community becoming a microscopic representation of India, mirroring the power needs of a rapidly growing economy.

However, the differentiators do play a very important role in the selection of media. Depending on the complexity and detail in the subject matter, as well as the particularity of the audience, a variety of media, ranging from folk theatre, to print, television and interactive\online platforms can be used in concert to mobilize public opinion en mass.

The communication effort, in addition to being broad-based across the renewables space, will eventually need to find a common thread through the various areas, issues, technologies and agendas to find common ground and transform public opinion into a driver and enabler - a force which fully recognizes the role and importance of renewables in our lines, and power us on our road to a greener tomorrow.

commercial, domestic agriculture sectors resulting in reduction in local pollution and adverse environmental impacts of using conventional energy sources. For example, in case of solar thermal systems, used for domestic applications result in electrical savings where same environmental benefits as that of renewable power generation are associated. With the use of solar thermal systems in commercial and industrial applications the local environmental benefit is more than that of estimated for conventional power generation. This is because of the fact that the commercial and industrial boiler/furnaces are smaller in size and no sophisticated emission reduction equipments are used. The biomass energy technologies like the biomass gasifier which replace the traditional ways of using biomass have positive environmental impact through reduced biomass consumption.

The above analysis indicates that the environmental impacts of renewables, though difficult to quantify, are substantial.

SOCIAL IMPACTS

The renewable energy technologies, in addition to supplying clean and environment friendly energy, also have social dividends. By the very nature renewable energy sources are dispersed and thus the associated benefits are accrued in the non–urban areas where they are actually required. The two major renewable energy applications that have social development dividends are the rural applications and grid connected power generation through renewables.

The renewable energy technologies supply energy in the remote and rural areas e.g. through renewable based mini-grids or individual photovoltaic systems. These have very high social impact in these areas, which were earlier relying on primarily biomass or conventional fuels like kerosene or diesel. The provision of lighting results in facilitating the education with availability of lights. In case of small businesses/shops the working hours can be extended resulting in economic wellbeing.

Through the surveys conducted in the remote and rural areas for electrification, it was found that entertainment is one of the important social requirements. Provision of energy, through locally available renewable energy sources, enables the rural population to have access to channels of entertainment like television, radio etc.

Employment generation at the local level is most important social impact of renewable energy technologies in rural areas. The need to operate and maintain the renewable energy systems locally makes sense. This leads to requirement and thus leading to development of local skills and entrepreneurs operating and maintaining these systems. Further the availability of energy trigger economic development by development of micro-industry and energisation of pumpsets for irrigation etc. The local energy provision generates employment by providing electricity as an input for productive uses in agriculture and rural industries. Thus the renewable energy technology in the rural areas does not provide energy only but also provides livelihood.

The new thrust on rural electrification through local participation of village communities and village panchayats also have a positive social impact as the local community owns and controls these systems leading to their empowerment.

The social impacts of large size grid connected renewable energy power projects are in terms of employment generation and local development. It has been estimated that the renewable energy projects have more employment generation potential than the conventional power sector. It is estimated that a wind farm provides four times more jobs in operation and maintenance than the conventional power plants. The renewable energy power projects also helps in building the local small industry / entrepreneurs to meet the requirements of the power plant and personnel stationed at the site. Further, the renewable energy projects in rural areas lead to local infrastructure development e.g. roads, electricity etc. in the process of setting up these projects.

Thus the provision of energy through locally available renewable energy sources improves the quality of life of the rural people through lighting of

rural homes, streets, provides access to education, entertainment & generates employment opportunities in rural areas.

SUMMARY

The renewable energy technologies thus provide energy in decentralised as well as distributed form, which is much needed in case of India, along with environmental benefits and social dividends. The environmental benefits though measurable are difficult to quantify in terms of economic impact. However, the studies show that the environmental impacts are substantial, and if included in the cost, it makes the energy cost of conventional energy higher and comparable with renewable energy. Similarly in the case of social benefits, which are especially high in case of rural areas, should be considered while comparing renewable energy with other energy sources.

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GLOBAL WIND POWER MARKET INCREASED BY 43 PERCENT IN 2005

The global wind energy sector experienced another record year in 2005. According to the figures released by the Global Wind Energy Council (GWEC) for 2005, the installation of 11,769 megawatts (MW), which represents a 43.4% increase in annual additions to the global market, was up from 8,207 MW in the previous year. The total value of new generating equipment installed was more than Euro 12 billion, or US$14 billion. The total installed wind power capacity now stands at 59,322 MW worldwide, an increase of 25% compared to 2004.

The countries with the highest total installed capacity are Germany (18,428 MW), Spain (10,027 MW), the U.S.A. (9,149 MW), India (4,430 MW) and Denmark (3,122). India has thereby overtaken Denmark as the fourth largest wind market in the world. A number of other countries, including Italy, the UK, the Netherlands, China, Japan and Portugal have reached the 1,000 MW mark of installed capacity.

In terms of new installed capacity in 2005, the U.S. was clearly leading with 2,431 MW, followed by Germany (1,808 MW), Spain (1,764 MW), India (1,430 MW), Portugal (500 MW) and China (498 MW). This development shows that new players such as Portugal and China are gaining ground.Europe is still leading the market with more than 40,500 MW of installed capacity at the end of 2005, representing 69% of the global total. In 2005, the European wind capacity grew by 18%, providing nearly 3% of the EU's electricity consumption in an average wind year. The growth in the European market in 2005 only accounted for about half of the total new capacity, down from nearly three-quarters in 2004.

Nearly a quarter of new capacity was installed in North America. The U.S. wind energy industry broke earlier annual records of installed capacity by installing nearly 2,500 MW, which makes it the country with the most new wind power.

In 2005, Asia accounted for 20% of new installations. The strongest market here remains in India with more than 1,430 MW of new installed capacity, which takes its total figure up to 4,430 MW. The goal for wind power in China by the end of 2010 is 5,000 MW," said Li Junfeng of the Chinese Renewable Energy Industry Association (CREIA).

ENERGY MANAGEMENT IN INDIAN REFINERIES

M. Bandhopadhyay*

INTRODUCTION

In the recent years the crude price is increasing by leaps and bounds. It has gone up from $3-7 per barrel to $65 per barrel with in a span of six years. This increased crude price has threatened the refineries to their operating cost so as to remain in the business of refinery. Therefore there is a tremendous pressure to curve the operating cost of the refinery. In this regard each refinery is having one energy cell to monitor the energy consumption level of the refinery and suggest energy conservation activities to reduce the energy consumption level of each refinery. Refineries are also carrying out energy audits through external world class companies like Shell, BP etc. to set bench mark for their energy consumption as compared to global best refineries with the same configuration of process units in the refineries. As a measure of reduction of operating cost, refineries are going for the purchase of cheaper crude i.e. high sulphur containing crude resulting increasing emission of SOs and NOx. The stringent BIS standard of future fuels along with high sulphur crude processing in refineries are compelling to put sulphur recovery units. Hence, result and effect of all above process has force refineries to optimize and reduce the energy consumption of their process units and equipments.

With the enactment of Energy Conservation Act - 2001, it will be mandatory to post one Energy Manager for each refinery so as to monitor the activities related to energy conservation. Accordingly all the refineries by this time are posting one Energy Manager (who has passed the Energy Manager Examination). Besides above criteria the fact remains there is plenty of scope to optimize and reduce energy consumption in all the process units and thermal power plants in the refineries. With this background this paper briefs about the energy management in Indian refineries.

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Generally the following tools are being used in the refineries for the management of energy

1. Benchmarking
2. Targeting
3. Specific Energy Consumption

Benchmarking: Benchmarking is a tool for ongoing search for best practices that produces superior performance with the same configuration in other refineries adopting and implementing the same improving performance.

Targeting: Fuel and electricity target is a figure set for each of the process units of the refinery. This target is based on actual performance for past two years and adopting a stringent target taking into consideration of modification / corrective engineering be carried out under the contain of existing configuration.

Specific Energy Consumption (SEC): A scale to assess the present performance level of a refinery with respect to energy consumption and hydrocarbon loss and the same is compared to other refineries. This is expressed in terms of mbtu/bbi/NRGF. NRGF (Energy Factor) is a factor, which is estimated as a ration of energy consumption of each process unit to that of crude Distillation Unit.

ATTRIBUTES OF ENERGY CONSUMPTION AND FACTORS AFFECTING THE ENERGY CONSUMPTION

1. Fuel
2. Power
3. Steam
4. Cooling Water

The factors that affect the energy consumption level in refineries are as follows:

1. Refinery Configuration
2. Type of feedstock being processed
3. Severity of operation;
4. Vacuum system employed;
5. Steam and power-balance;
6. Process Technology;
7. Field Pattern;
8. Mandate in product specification;
9. Environmental regulations; and
10. Flexibility in operation.

VARIOUS APPROACHES FOR ENERGY CONSUMPTIONS

The approaches are

1.Equipment Oriented Approach
2.General Approach
3.Advanced Approach

Equipment Oriented Approach

The scope for energy optimization and reduction for various equipments are cited below

Fired Heaters

The scopes for optimization vis-á-vis reduction of energy consumption are as follows:

1.Reduction of flue gas temperature;
2.Reduction of excess air;
3.Reduction of radiation loss
4.Selection of right auxiliaries.

Reduction of flue gas temperature

Various options for the reduction of flue gas temperature are as follows.

1.Increasing convection section duty/area;
2.Heating up other process streams in the convection bank of the furnace;
3.Preheating of air to burners of the furnace
4.Generating steam or heating BFW (Boiler Feed Water)

It is worthy mentioning here that by reducing the stack temperature by 20°C, efficiency of the furnace can be reduced by 1% approximately.

Increasing the convection section duty/area

l. By putting additional tube rows in the convection section
2. By changing no. of passes in convection coil
3. By providing efficient corbelling to avoid flue gas by pass
4. By providing additional clearance in the convection zone and carrying out on line cleaning.

Introducing Air Preheating

I. Convection mounted air preheater (APH) with 1=D fan and without ID Can
2. Ground mounted APH with FD and ID fans.
3. Run around coil system (using hot oil or water).
4. Open channel air preheater (OCAP)

Generating steam/heating BFW

If additional steam is required then this is the last preferred choice.

Reduction of Excess Air

Excess air is the common problem with all the refineries and refineries are, losing energy most of time on this account. For every 10% increase in excess air the furnace, efficiency is reduced by about 1.0% and the ideal approach is to maintain the % O_2 levels <2% (for gas firing).

By adopting the following, the excess air in fired heater can be controlled/reduced.

1. By putting on line O_2 analyzers and controlling the same with regular monitoring.

2. By putting better combustion control system.

3. By adopting better Burner Management by regular cleaning and replacing the old burners with new burners.

Radiation Loss Reduction

In a fired heater, the setting loss is normally in the range of 2 - 3% of the fired duty. The loss very often goes beyond 2 - 3% and can be controlled/ reduced by adopting any of the following modifications.

1. By putting ceramics fiber linings on the inside refractory wall on the furnace
2. By putting steel reinforced lining
3. By putting vacuum formed fiber-board lining.

Besides above periodic monitoring temperature of furnace surface with the help of infra red scanner can identify any damage of insulation and hot spots on the furnace.

Choosing Right Auxiliaries

Soot Blowers

Good efficiency of soot blowers by way of keeping the clean surface of the convection zone tubes to ensure energy conservation.

Following two types of soot Blowers are used in the refineries.

1. Retractable Soot Blowers - This is very cost effective and best choice for fuel having high level of metal content (Vanadium, Sodium) or Sulphur.

2. Sonic Soot Blowers- Energy efficient and reliable

While selecting soot blower it should be checked that each blower should not cover more than 4 tube rows on either side or 1.2 m which ever is less.

Burners

The contribution of burner efficiency towards total furnace efficiency is 5%.

The modern design of furnace envisages atomizing steam to fuel ratio close to oil with isolated cases which can go below up to 0.05.

FD/ID Fans

Selection of sizing of FD/ID fan is very important from the energy conservation point of view, Most of the time refineries keep sufficient margin in the design keeping in mind future capacity augmentation of the units. Hence to conserve energy in the present context variable speed drive (VFD) for the motors are very effective. While selecting the motor for the FD and ID fans, energy efficient motor should be chosen to save considerable amount of energy.

Dampers

Stack Damper maintenance and control is very important so as to maintain the furnace arch pressure in case of balanced draft furnace slightly higher than atmospheric so as to prevent any ingress of air into the furnace resulting prevention of energy loss.

Heat Exchangers

The following options are available for energy conservation in heat exchangers

1. Use of pinch technology for Heat Exchanger Trains to optimize and to integrate heat.
2. Use of plate heat exchanger.
3. Use of Turbulence promoters.
4. Use of high flux tubes.
5. Reduction of pressure drop (so as to sustain velocity of the fluid) by simplified piping arrangements.

Plate Heat Exchangers

For maintaining close temperature approach and utilize heat energy even with wide variation of flow rate, the plate heat exchangers are very effective.

Various types of plate heat exchangers which are nowadays used in the refineries are as follows: -

Welded Plate Exchangers

Wide Gap Exchangers

Double Wall Exchangers

Graphite Plate Exchanger

Spiral Heat Exchanger

Turbulence Promoter

This is very effective for high viscous fluids in the tubes. Various types that can be used are mentioned below

Twisted tapes

Hitran Inserts

Grooved tubes

High Flux Heat Transfer Tubes

High Flux Heat Transfer Tube with aluminum porous coating can reduce energy consumption level significantly.

Reduction of Fouling of Heat Exchangers

To take care of heat loss due to fouling of exchangers, the fouling fluid should be placed on tube side for vaporizing type fluid handling in Thermo Siphon Reboilers. Vaporization to be restricted to <30% to avoid scaling/fouling. In case of temperature dependent fouling (polymerization fouling) tube wall temperature to be restricted. Use of on–line doping of anti–foulant can reduce fouling to great extent. The easy process to reduce fouling is on–line mechanical cleaning of exchanger. In such case one parallel exchanger is bypassed, isolated and the same is cleaned mechanically.

Distillation Column

Reduction of pumping energy to the distillation column and utilization of column heat are the two areas where energy saving potential in distillation column exists.

Reduction of energy in Distillation Column Operation

It can be done by taking following actions

(i) By incorporating high efficiency/ low pressure drop packings in the column

(ii) By incorporating dry vacuum in the vacuum column.

(iii) Minimizing over flash

(iv) Proper utilization of heat of the column

(v) By operating reflux ratio

(vi) By reducing overhead condenser load and reboiler load.

(vii) Minimizing stripping steam in the column.

Air Compressor

In each refinery there is a scope to save energy by way of reducing the set pressure from 7 kg/cm^2 to 5.5 kg /cm^2 (at the farthest end of the refinery) considering pressure requirement for instrument air to be as 4 kg/cm^2 and line pressure drop. By doing this each refinery can save energy which is equivalent to atleast Rs 1 crore per annum. Again by arresting air leak from a 3 mm diameter hole can save energy equivalent to Rs.1.2 lakh per annum. However, in refineries few portable compressors are needed for some special pressure testing jobs where high pressure air is needed.

Cooling Tower

By incorporating on-off control system for the cooling tower pump and cooling tower fans cascaded with the outlet temperature of water can save energy which is equivalent to minimum Rs.1 - 3 lakh per annum.

Electrical Motors

By replacing the less energy efficient motors having less than 85 % with energy efficient motors

energy saving of minimum Rs.25 lakh/kWh per annum is possible for a refinery size of 3.5 to 4 MMT/annum The simple pay back period for such replacement is 5-10 months.

GENERAL APPROACH

Energy saving in captive power plant

Now-a-days most of the refineries have cogeneration and combined cycle power plants which are efficient ways of generating power. The advantages of such systems are as follows:

(i) Maximum efficiency
(iii) High Reliability
(iii) Flexibility in fuel used
(iv) Low operating cost for power generation
(v) Low payback period.
(vi) Low NOx emission
(vii) PRDS operation is avoidable

Refineries are now installing GT–based cogeneration and combined cycle power plant. The various components of the plant are (i) Gas Turbine Generator (GTG) (ii) Heat Recovery Steam Generator (HRSG) (iii) Steam Turbine Generator (STG). The efficiency of such system is around 85 %.

Energy saving in steam network

Considerable amount of energy saving can be achieved from the steam network of the refinery by taking following actions.

i) Modelling and optimization of the steam network;
ii) Proper insulation of Steam network;
iii) Efficient use of steam traps and condensate recovery system;
iv) Minimising steam venting;
v) Recovery of LP steam by flashing HP/MP condensate;
vi) Installation of temperature controller on tank heating coil;
vii) Installation of tank for the storage of hot steams and product (internal fuel oil, fuel oil, bitumen, reduce crude oil etc);
viii) Installation of RO of correct size in snuffing steam, purging steam and gland sealing lines;
ix) Installation of Balanced Pressure Thermostat (BPT) traps on open ended copper tube; and
x) On line sealing of leaked flange of steam valves.

As there is a high potential of energy saving in the steam network system, periodic audit is very much essential to take care of steam leakage and energy loss in the steam network. Steam (at a pressure of 7 kg /cm^2) leak from a hole of 3 mm diameter is equivalent to 9 Tones of oil per year.

Besides above there is ample scope to save energy in the air conditioning area for control rooms and office buildings and illumination system.

Advanced Approach For Energy Conservation In Refineries

Besides the general approach as discussed earlier the following advanced approaches can be made to conserve energy in the refineries.

(i) Heat Pump - The over all energy requirements of the column can be reduced significantly by using a heat pump for integrating the functions of the re-boiler and condenser in a distillation column. Heat input to the re-boiler is accomplished by the heat 'liberated by condensing refrigerant. The condensed refrigerant leaving the re-boiler as liquid evaporates in the overhead condenser thereby removing heat from the overhead vapour. Heat pumps find extensive applicability where chilled water or direct refrigerant is required for condensation. Another area where it can be used is the use of high pressure steam in the re-boiler with no heat recovery at the condenser.

(ii) Vapour recompression - In this system the vapour of the column is compressed and condensed thereby using the heat liberated by condensation to reboil the bottom liquid. It has been estimated that a conventional column with steam heating and water cooling may use 10 times the height of a column running with vapour recompression.

(iii) Intermediate Re-boiler & Condensors Efficiency of the distillation column can be increased in–effect by increasing the number of trays by incorporating multi re-boilers and multi condensers in the two sections of the column viz., in the rectification and stripping sections respectively.

Split Tower Arrangement

Splitting the feed into two equivalent streams and distilling in two smaller columns operating at different pressures can cut down the energy requirement to almost half of that of conventional single column distillation. Here the condenser duty of the high-pressure column should match with the requirement of re-boiler duty of the low pressure column.

Use of Inert Gas in place of steam as striping agent can also reduce the energy consumption by 20-30% of the energy being used in a process unit.

CONCLUSION

There is an ample potential for energy saving in a refinery. The general approach of energy conservation as discussed above for furnaces, heat exchangers, distillation column, cooling tower. air compressor, motors and steam network can save energy to the tune of minimum 7- 10 % of total energy consumption by the refinery. Advanced approaches like heat pump, vapor recompression, split tower arrangement, inert gas stripping can save energy of distillation section by a further 5-10% minimum. ❑

IREDA OFFICIAL APPRECIATED BY HRC, HANGZHOU, CHINA

During TCDC 2005 at Hangzhou, China, Shri K. Yeptho, Deputy Manager, (PTS), IREDA was elected as class monitor among 29 participants from 16 countries. Shri Yeptho was also given a responsibility to chair all the country presentations and University interaction for three days.

The Founder Director and now Honorary Director Prof. Zhu Xiazhang in his presentation at the closing ceremony of TCDC has appreciated Shri Yeptho for his effective monitor role and contribution in co-organising of the workshop with HRC.

He was also appreciated for his presentation on "Power Sale and Purchase Agreement." An english translation of the paper has been put up on HRCs homepage: www.hrcshp.org.

HYDROGEN FROM BIODIESEL USING STEAM REFORMER

InnovaTek and Seattle BioFuels announce the first successful production of hydrogen from 100% biodiesel in a micro-channel steam reformer. This is the first time a renewable fuel source has been used to produce hydrogen in a micro-channel steam reformer to power emission-free fuel cells. InnovaTek's reforming system was initially developed to produce hydrogen from fossil fuels. In addition to biodiesel, InnovaTek has also used its technology to produce hydrogen from glycerol (a by-product of biodiesel production), and the raw soybean oil that is used to manufacture the biodiesel fuel. The use of glycerol as a source for hydrogen has the additional advantage of producing a valuable commodity from a by-product of biodiesel production. This benefit contributes favourably to the economics of biodiesel as a fuel that is competitive with petroleum diesel fuel. InnovaTek successfully demonstrated the ability to generate hydrogen from pure biodiesel (B100) produced at the Seattle Biodiesel production facility. One of the advantages of InnovaTek's technology is the use of micro- or milli-channel geometries for the catalytic reactor and heat exchangers. Microchannel reactors offer some distinct advantages over conventional reactors (tubular or vessel), including inherent safety, compact size and high conversion rates. The micro-channel reformer achieved a 100% conversion rate of the pure biodiesel (B100).

Source: www.RenewableEnergyAccess.com

SOCIAL IMPACTS & BENEFITS OF RENEWABLE ENERGY APPLICATION IN RURAL AREA WITH EMPHASIS ON WOMEN

Lalita Balakrishnan*

More than half-a-million Asian children die annually from diseases brought on by indoor pollution", estimates a recent repost entitled "Smoke, the killer on the kitchen" from an International Charity based organization in the U.K., ITDG (The Intermediate technology Development group). Most affected are children and women in rural areas of China and India."

The December, 2005 Issue of Readers' Digest reports also that, according to Dr. Raj P. Singh, a respiratory physician, "a large number of children & mothers, wheeze, cough & have watery eyes and if not treated quickly and properly, irreversible damage to their lungs will occur". This is in village Tirupalaivanottor in Kerala, where there is no polluting industry, no heavy vehicular traffic, emitting a petrochemical haze – the culprit is the cookstove in the thatched one-room hut, six meters square with beds one side, and the "Chulha" on the other side, with a pile of twigs and branches stacked, along with dung cokes." A number of studies have shown that the use of solid fuels like animal dung, wood, coal and crop residues in poorly ventilated and unvented stoves generate toxic fumes that damage the mothers' as well as children's health. Many of these women realize that the smoke from their traditional stoves and biomass fuels causes the health problems but are unable to change over to better fuels or stoves owing to their abject poverty.

However, in some of the other villages in the same State, the experience is different whenever there has been the project NPIC (National Programme of Improved Chulha) undertaken by the All India Women's Conference (AIWC) and their members. The new Department of Non-Conventional Energy Sources (DNES) identified AIWC as a Nodal Agency in 1986 for the NPIC Programme (National Programme of Improved Chulha) and later in 1996 by MNES for NPBD (National Programme of Bo-gas Development). For over two decades now, AIWC has been implementing the above national programmes as well as Solar Thermal and SPV programmes with direct funding from the Ministry and with a mandate to work all over the country through the AIWC selected branches from among 500 and partner NGO's mainly recommended by AFPRO for the NPBD programmes.

The technical support was provided by the Indian Institute of Technology (IIT) at Delhi (RD & AT) and Kharagpur, Thapar Polytechnic (Patiala), AFPRO and other technical institutions. More than two decades of experience in the implementation by AIWC of the most important domestic devices of RET (Renewable Energy Technologies) have shown that, wherever women whether in rural or semi-urban areas, educated or illiterate when given awareness and training in construction & maintenance, correct usage and trouble-shooting of the other devices, these are all being used continuously and the programmes have become sustainable.

AIWC has constructed more than 3 lakh improved cook-stoves, single pot, double-pot and community chulhas. At village, Muthupillaikadu, Kollam District of Kerala, the AIWC branch, Kerala Iykiam Mahila Samajam, has conducted, in the mid eighties the awareness as well as a 10-day training programme creating 20 self-employed workers. The young women and girls had studied up to Matriculation and came to from the training rather reluctantly. But, after the 10-day training, whereby they had to construct at least three smokeless chulhas with their own hands and grasp the technical aspects and benefits of their use, they had to pass the tests.

Those who had learnt the techniques very well, started constructing the fixed type, two-pot model

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in other houses, for which they got Rs.20/- per piece as fees. They could easily construct three chulhas per day, as the raw materials like mud, straw, bricks etc. were already kept ready by the house owners. This way the SEW's (Self-employed Workers) started earning a decent amount month and became happy. The important social impact was noticed in the men, particularly the husband of the three girls, who were not employed and wasting their wives' new found confidence and self-respect and acceptance in the community. They rapidly changed their insolent ways and started helping their wives in the installation and gradually moved on to other jobs.

In a small village in Gujarat, where we had gone to monitor the NPIC programme conducted by the Gujarat branch AIWC, an old villager requested us to visit his house. We saw a sparkling kitchen, with cooking and other vessels, neatly arranged in the shelves and the cooked food neatly kept near the improved chulha, which was also very clean with no sign of smoke nor soot. This had brought her a lot of appreciation and respect in the family as well as the community.

In Trivandrum most of the households had opted for the more – expensive "Parishad" model cookstove. All had been exposed to R.E.T. devices like improved chulhas, solar box cookers etc. All houses had trees, which provide a lot of biomass fuel. The housewives used the biomass in their improved stoves to make a host of traditional foods for the market and earned a decent livelihood.

Similar experiences have been seen by a number of organisations in the States of Andhra Pradesh and Tamilnadu. Tribal women SEW's have become so good in the construction of two – pot pottery – lined fixed model chulha. Even though NPIC has been discontinued as a Central Government Programme and transferred to the States, Guntur Mahila Samajam continues to implement the NPIC programme in collaboration with the A.P. Forest Department, who identify the beneficiaries and monitor the programmes. The potter who has been supplying pottery for this programme has also become a successful entrepreneur, and he had been able to diversify his business by acquiring a couple of lorries and earning more money.

In Karnataka and A.P. the members of self-help groups have gone in for "permanent cement chulhas", which they find more convenient to use as they can be used for a long time without major maintenance. These women do not mind spending more, as they could get loans from their groups. They have evolved their own method of constructing the new permanent cement and brick chulha. They construct the chulha outside the kitchen on a piece of wood or thick press board, and they go on curing the chulha with a sprinkling of water for nearly 3 to 4 weeks which prevents the cracking of the surface. They have also been able to evolve the correct proportion of cement, mud and "Chuna" (Lime) to be used while constructing the chulhas.

In short, whenever women have been exposed to the NPIC programme and given the training and refresher courses improved chulhas have not only been accepted but also continue to be used, and have empowered women by supplementing their income.

Among all the programmes initiated by MNES for the women, the NPIC programme has been regarded as the most important. In fact, they consider it as a "Health project", since they and their children are saved from a number of smoke-related diseases, asthma, cough, lung and eye-infections, etc. They also realize that because of the lower consumption of fuel, they need not go to the forests for fuel collection, thereby reducing the risk of injuries and damage to their spine. Women have also appreciated the drudgery reducing aspects like less time for cleaning vessels and also the walls in the kitchen.

Solar Thermal devices like the Box-type cookers, taken up from early 1982-93, for demonstration-cum-training workshops by AIWC. After this training programme, the Chennai branch of AIWC, Women's Indian Association, started giving regular demonstrations programmes at public meetings, schools & colleges the media. The women of Chennai accepted the cooker with enthusiasm creating a demand for box-type solar cookers in Tamil Nadu.

Such training programmes were also conducted in Lakshadweep Islands. The response of the local women was tremendous. Women were keen to adopt the solar cooker, as coconut husk & shells were the only available fuels. The women could not believe their eyes, that kheer, pulao, vegetables could be prepared to their taste, without any electricity or other fuels. The women in the Islands (mostly Muslims) were used to living alone for long periods, as their husbands were sea–farers, mostly on steam ships on long voyages. Women prepared coconut laddoos and special pickles out of the remnants of fish after packing them for export using the solar cooker.

AIWC has also been implementing the National Project on Biogas Development (NPBD) since 1996 as one of the Nodal Agencies of MNES, with technical help from AFPRO and IITs. The programme was conducted through AIWC branches and some NGOs as partners. Several 20-day training-cum-demonstration programmes for rural women on biogas including the construction and maintenance of biogas plants were conducted. One of the noteworthy example at Chunar in Uttar Pradesh, midway between Varanasi and Mughalsarai, where nearly 800 women have been trained in various income generating trades like carpet weaving, pottery–making and biogas units including fabrication and use, led by an extraordinary enterprising woman, Vijaya Rai, who saw to it that many biogas units were continuously functional.

Another enterprising rural woman, Lakshmi, the wife of a poultry farmer and she showed her skill by using the chicken droppings for generating biogas and utilizing the same for supplying gas through pipelines to six or seven houses and for preparing community meals for poultry workers in the village. It has been clear that the successful training and grasp by the young women keen to learn paid them rich dividends for the future.

Similarly, when our AIWC teams visited some villages in the 24 Parganas district of West Bengal, inspecting set-up biogas units, we were all pleasantly surprised by the extensive use of biogas and also the sparkling neat kitchens without any soot on the walls. In fact they had set-up the toilet attached biogas units, the gas from which, was used without any inhibition for cooking! This was possible through the 15,000 youth and women's groups created by Ramakrishna Mission all over Midnapore and surrounding areas and giving them complete awareness and counseling about the benefits of using RETs. It is not out of place to mention that Ramakrishna Mission was funded by AIWC for a number of years before they could access projects from the State government and now they have become one of the leading NGOs propagating RETs throughout West Bengal.

The same way another well-known NGO SDA from Kerala was given their first few biogas units by AIWC, Kollam branch – "Kerala SYKYA Mahila Samajam"– and in the course of time SDA has become one of the important NGOs working with funding from MNES constructing thousands of biogas units through their network in Andhra Pradesh, Kerala and Tamilnadu. Thus, AIWC has been a catalyst in developing important NGOs in the propagation of RETs.

SOLAR PHOTOVOLTAICS

MNES has been implementing a countrywide Solar Photovoltaic (SPV) programme for more than two decades. It has all the components to develop a cost-effective SPV technology and its manufacturing base in the country for large-scale applications of SPV systems in different sectors.

Under the demonstration programme, SPV systems for lighting and other applications are being installed across the country, primarily in the rural and remote areas. These SPV systems are portable solar lanterns, fixed type solar home lighting systems, street lighting

and stand-alone village-level power plants, which are supported by MNES for non-commercial users.

The Programme is implemented by Programme Implementing Organisations (PIOs) either by procuring the systems through the tendering mode and then distributing to the end-users or by allowing the SPV manufacturers to directly market their systems. AIWC has also been collaborating with MNES in this effort and two case studies are presented below.

Solar Lanterns

There are 20 odd stalls that began using solar lanterns in the Elliot Beach in Chennai that operate between 6 PM and 10 PM. An enterprising person has procured 24 solar lanterns and rents them out every night for a fee of Rs.10 per night with a cash deposit of Rs.100. Beneficiaries have said that they do not mind paying the charge and it gives sufficient light for the duration of their vending. They do not soil their hands with kerosene, nor do they need to spend on the replacing the mantle. It is neither hot to touch. Three years since the first solar lanterns made their appearance hundreds of such lanterns are being used along the beach.

In another instance AIWC implemented the National SPV Programme through the market mode with the help of MNES in the States of Bihar, Orissa, Karnataka and Delhi. Solar systems and solar lanterns were installed and sold in the remotest districts where electricity grid were not available. A recent evaluation was carried out on the projects in a number of villages in the Kolar district of Karnataka. Central Power Research Institute conducted the study and found that "in general all the beneficiaries in the village comprising various classes of the society were fully satisfied with the system rendering a four hour service daily without any problem, wherever needed. They appreciate the fact that electricity was available to them whenever they needed it".

CONCLUSION

Since a large number of SHGs and other NGOs have now become interested in the use of solar appliances, donors and government programmes should assure integration of RET dissemination and income generation in their funding patterns which are incorporated into RET programmes.

Experience has shown that the NGOs intervention as a catalyst for hand holding at for a few years is essential for the SHGs to be successful. Capacity building of NGOs concerned alongwith enough funds to carry out their activities properly is also a must.

NGOs are still seen as downstream partners when donors relate to the host country government and the government's meanwhile often eliminate NGOs from their donor agreement thereby backshelving the NGOs in planning and objective formation stages. These are words by Mr. Adam Friedensohn on the experience of Himalayan Light Foundation in Nepal.

Although until recently gender issues were not considered particularly relevant to the establishment of energy policies and programmes, it is now apparent that societal pressures for greater gender equality and for more sustainable and effective energy systems can be mutually reinforcing.

Energy interventions can become more effective when they are responsible to the needs of different users in different conditions. Reaching this goal will require changes in how energy programmes are formulated and implemented. Much more difficult goals like electrification, space, ICT revolution have been achieved, but the basic problems of water and fuel for the rural poor, especially women are still not addressed. These women manage a considerable portion of the energy system and that role should continue by empowering them with investment.

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WIDENING THE AMBIT OF DECENTRALISED POWER PLANTS

C.R.Bhattacharjee*

Decentralised power plants have entered into the stage of regular power planning for rural India. This bears a special significance on account of limits of scope for grid line to approach remote villages and islands. It is a compulsion on account of social obligation for power to all to move towards improving quality of living. Resources like solar, wind, biomass, biogas, small hydro, etc., by and large, being locally available and at the back drop of very high cost of extension of grid line or absence of technical feasibility, decentralised off-grid power plants yielding energy at affordable cost are now envisaged for rural electrification. Noteworthy blessings are this power is pollution free and available on sustainable basis. Even where non-approachability of grid line is a non-issue, decentralised power in the country has a special merit stemming out of the philosophy "small is beautiful " on many occasions.

There is a new dimension now cropping up in the power supply scenario with epicenter of power generation shifting from load centre to the areas having proximity to feed stock and other main inputs considering constraints in transport, time, cost and risks. Unlike earlier practice, ultra high voltage AC or DC transmission will be wheeling power from mega-generating stations to load centres. Distribution will originate from voltage levels much higher to present transmission parameters in order to negotiate high quantum of bulk power in this process. Fact remains number of generating stations will get reduced, transmission and distribution will gain prominence and in the whole network, rural consumers are situated at the tail end.

Indian scenario in the existing system of supply in rural areas displays certain characteristics that are damaging to the interest of consumers emanating from technical shortcoming and a spirit of indifference that confronts the ethics of customers' care. These are quantitatively inadequate and poor quality of power in the rural areas, often exposed through low voltage profile, frequency falling below specified limit, priority to disconnect rural feeders while load shedding is inevitable, interruptions due to frequent faults, delay in attending consumers' calls, etc. Farmers subjected to uncertainty to run pumps for irrigation or burning motors because of suppliers' fault is common phenomenon even in states where percentage of rural electrification is high. Overall shortage in power availability, weak transmission and distribution net work, non-remunerative revenue, low density of consumers and power intake, substandard quality of construction of distribution system, tail end location of rural consumers and nevertheless, spurt in theft and hooking are factors responsible for pathetic condition of rural power distribution in the overall utility services through grid set up. Distributed power supply in these areas would find remedy to the many of the existing deficiencies by acting in tandem with grid source to supplement each other.

Ambit of planning for distributed power supply, thus should be spread out to include electrified villages and urban/semi-urban areas elaborating the conception beyond present limitation of the idea exclusively meant for remote unelectrified villages. This should be done in the interest of better service to the consumers, gainful utilisation of locally available resources capable to deliver benign power, improve tail end voltage of the system and relevant in the context of overall shortages at the national level to the tune of 5-8% of energy requirement and 10-15% in demand during peak hours. Distributed power supply will offer opportunities for village level ownership, management and employment of local people after some training. Overall capital cost of additional generation will be competitive to conventional power. There will be contribution to taper-off peak demand. Above all, utilisation of resources otherwise going waste will be a realty. While grid interactive solar energy for heating / lighting and municipal waste are two options suitable

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for application in urban installations other forms of resources cab be harnessed depending on availability, viability and local conditions.

These renewable resources should be viewed as important ingredients for power generation as good antidotes to contain green house gas emission. Countries like India will have extra earning from CDM benefit that is likely to reach globally $15 billion worth of trade. New resources of renewable energy are advancing from R&D and technological innovation to the field level application. In the coming decade Hydrogen and fuel cell in transport, small and big stationary power will play vital roles. Along with conventional power, it is essential that small distributed power from renewable resources is encouraged vigourously as is being done in developed countries, in the attempt to strive for 20 percent share of the total installed capacity of power within the next decade and a half. ❑

SOLAR-DIESEL HYBRID POWER PLANT COMMISSIONED IN INDIA

Bharat Heavy Electricals Ltd. (BHEL) has successfully commissioned a solar-diesel hybrid power plant at Bangaram Island in Lakshadweep, in what the company claims will become the largest in India, conserving the ecology and environment of the tourist island while meeting its increasing demand for power.

The system works in fully automatic mode by prioritizing on solar power. A software algorithm ensures SPV array to operate at the maximum power point so that the solar modules deliver maximum power at the given solar radiation at that instant. The system can monitor the system performance from a remote location via a telephone line.

Initially, a 10 kW Solar Power Plant was commissioned by BHEL in the island using solar photovoltaics (SPV). Based on its success, Lakshadweep Administration decided to commission a 50 kW Solar-Diesel Hybrid Power Plant to ensure power supply 24 hours a day.

The SPV-diesel hybrid system at Bangaram comprises a 50 kW SPV array containing SPV modules manufactured with high-efficiency single-crystalline solar cells, maintenance-free lead acid battery bank, two numbers each of 75 kVA [Kilovolt-Ampere] diesel generators, a power conditioning unit (PCU) and other associated auxiliaries.

The system works in fully automatic mode by prioritizing on solar power. A software algorithm ensures SPV array to operate at the maximum power point so that the solar modules deliver maximum power at the given solar radiation at that instant. The system can monitor the system performance from a remote location via a telephone line.

BHEL has already commissioned solar power plants adding more than 1 MW to Lakshadweep's generating capacity. Spurred by the success at Bangaram Island, the Electricity Department of Lakshadweep is planning to install similar systems in other islands as well.

Source: RenewableEnergyAccess.com February 27, 2006

WHAT IS ENCON

Energy Conservation is an Attitude

Energy Conservation is a concern of one and all

Energy Conservation is every one's moral responsibility

Energy Conservation is for future generations

Energy Conservation is to conserve our resources and environment

उड़ीसा में ग्रामीण ऊर्जा–सुरक्षा का एक अनुभव

उड़ीसा में 'ग्राम विकास' नामक स्वैच्छिक संस्था गरीबों और वंचितों के लिए पिछले 25 वर्षों से सेवारत है। हमारा मिशन यह है कि जो पूर्ण गांव के गरीब और वंचित परिवार हैं, उन्हें खाद्य–सुरक्षा, टिकाऊ आधार पर, समता जीविका के अवसर और ऊर्जा के स्रोत उपलब्ध कराके एक सम्मानूपर्ण सामजिक जीवन बिताने का मौका दिया जाए।

इस समय विकास के आधुनिक ढांचे में ऊर्जा की सुविधा उपलब्ध कराना विकास की प्रक्रिया का अभिन्न अंग माना जाता है। लेकिन ग्रामीण भारत में ऊर्जा–सेवाओं की स्थिति अत्यंत शोचनीय है और अधिकतर गांवों में खासतौर से गरीब परिवार इस जरूरी सहूलियत से वंचित हैं। ग्राम विकास इस समस्या से निपटने के लिए पिछले कई वर्षों से प्रयास कर रहा है, ताकि सरकार की सहायता से और सहायता के बिना तरीकों से इसका कोई व्यावहारिक और टिकाऊ हल निकाल सके।

सन् 1980 के बाद के दशक में हमने उड़ीसा में राष्ट्रीय बायोगैस कार्यक्रम शुरू किया और 56000 से अधिक बायोगैस संयंत्र स्थापित किए। इसके लिए 5000 के लगभग राजमिस्त्रियों और 600 सुपरवाइजरों को प्रशिक्षण दिया गया। इसके अतिरिक्त सौर ऊर्जा के साधन अपनाने की दिशा में भी काम किया गया और इन दिनों हम अक्षय–ऊर्जा के अन्य स्रोतों–लघु पनबिजली, बायोमास गैसीफायर और बायोडीजल के प्रचार–प्रसार में भी संलग्न हैं। पिछले दिनों ही सुधरे धुंआविहीन चूल्हों को गांवों में लोकप्रिय बनाने का काम भी बड़े पैमाने पर शुरू किया गया है।

ग्रामीण गरीबों को ऊर्जा–सुरक्षा प्रदान करने के इस अभियान में हमने केन्द्रीय अपारंपरिक ऊर्जा–स्रोत मंत्रालय के ''विलेज एनर्जी सिक्योरिटी प्रोग्राम' को सक्रिय रूप से अपनाया है। हम यहां अपने कुछ अनुभव बांटना चाहते हैं कि इस तरह के कार्यक्रम को सफलतापूर्वक किस तरह लागू किया जा सकता है। मूलतः हम यह मानते हैं कि गांव में मौजूद संस्थाओं की पूरी सहायता लेते हुए और उन्हें पूर्ण मान्यता देते हुए बिना किसी जातिभेद, लिंगभेद या किसी और भेदभाव के सर्वांगीण समतापूर्ण दृष्टिकोण अपनाकर काम करेंगे तो सफलता जरूर आपके चरण चूमेगी। हमें ग्रामीणों की क्षमता, कौशल, सूझबूझ और कर्मठता पर पूरा भरोसा करना होगा, फिर चाहे पेयजल की आपूर्ति का मामला हो या बिजली का या ईंधन का। इन सब बुनियादी जरूरतों को पूरा करने में 'ग्राम विकास' ने हर कदम पर इस दृष्टिकोण का पालन किया और यही दृष्टिकोण ऊर्जा–सुरक्षा के कार्यक्रमों में भी अपनाया गया।

उड़ीसा जैसे राज्यों में अक्षय–ऊर्जा के आवश्यक मूल स्रोत स्थानीय तौर पर ही प्रचुर मात्रा में उपलब्ध हैं। यहां जमीन के काफी बड़े हिस्से पर घना और हरा–भरा जंगल है, जो लकड़ी और बायोमास का अच्छा स्रोत है। साथ ही तिलहनी पौधे और फसलें भी होती हैं तथा राज्य के दक्षिण–पश्चिम भाग में पानी के अच्छे स्रोत हैं – खासतौर से कालाहांडी और कोरापुट जिलों में। धूप भी पूरे साल खिली रहती है। लेकिन जिन समुदायों के बीच हम काम करते हैं, उनमें अधिकतर आदिवासी और भूमिहीन गरीब परिवार हैं जिनकी इन सभी प्राक तिक स्रोतों तक पहुंच नहीं है, खासतौर से जंगल और जमीन पर उनका अधिकार नहीं है। ग्राम विकास उनका सशक्तीकरण करके उन्हें इस लायक बनाने की कोशिश में लगा है कि वे इन स्रोतों तक पहुंच बना सकें और अपनी ऊर्जा की आवश्यकताओं की पूर्ति कर सकें।

हमारा लक्ष्य यह है कि ऊर्जा–सुरक्षा का स्वरूप ऐसा हो कि वह टिकाऊ आधार पर इन परिवारों को लगातार सालोंसाल उपलब्ध रहे और उनकी जीविका–सुरक्षा और खाद्य–सुरक्षा भी सुनिश्चित हो। हमें यह भी आशा है कि ऐसा करने से इन परिवारों का रहन–सहन ऊंचा उठेगा और वे एक सम्मानपूर्ण जीवन जी सकेंगे। इसलिए हमारे काम को ज्यादा हिस्सा कुदरती तौर पर उपलब्ध बुनियादी साधनों को विकसित करने का है, उदाहरण के लिए जलसमेट (वाटरशेड) विकास, वृक्षारोपण, बंजर जमीन के पट्टे आदिवासियों के नाम कराना और जंगल के गैर इमारती लकड़ी वाले उत्पादों को बटोरने और इस्तेमाल करने का अधिकार दिलाना।

'ग्राम विकास' ने यह अच्छी तरह समझ लिया है कि गांव में काम करना है, तो वह गांववालों की भागीदारी से उनसे ही कराना है। संस्था का काम तो उन्हें इसके लिए तैयार करना, उनमें इस बात का भरोसा पैदा करना कि वे चाहें तो अपना भला अपने–आप कर सकते हैं और इसके लिए जरूरी साधन मुहैया करने तक और उन्हें जरूरी सहारा देने तक सीमित है।

जनता की भागीदारी ही इस तरह के कार्यक्रमों की सफलता का मूलमंत्र है। यही 'ग्रामविकास' की कार्यप्रणाली का केन्द्र बिंदु भी है। इसीलिए ग्रामविकास जब इन लोगों के बीच काम करता है तो उनसे शारीरिक काम करने और इन सुविधाओं का खर्च उठाने की भी उम्मीद करता है, फिर चाहे ऊर्जा–सुरक्षा का काम हो, या पेयजल की आपूर्ति का या फिर सुधरे चूल्हे बनाने का। इसलिए प्रारंभ में जो भी खर्चा होना है, वह गांव के लोग ही आपस में चंदा करके जमा करते हैं। वे ही गीली मिट्टी और पुआल इकट्ठा करते हैं और उसे चूल्हे बनाने में इस्तेमाल करते हैं। नालू और लकड़ी का बुरादा या छोटे टुकड़े भी वे ही इकट्ठे करते हैं और वित्तीय व्यय के अतिरिक्त श्रम भी उन्हीं का लगता है।

'वीईएसपी' अर्थात् 'विलेज एनर्जी सिक्योरिटी प्रोग्राम' की मार्गदर्शिका में अपारंपरिक ऊर्जा–स्रोत मंत्रालय ने साफ–साफ लिखा है कि ऊर्जा की जो भी प्रणालियां गांवों में स्थापित की जायें, उनका स्वामित्व स्थानीय ग्राम पंचायत के पास रहेगा। अगर पंचायत मजबूत और सक्षम है तो यह सिलसिला कायम रहता है, नहीं तो बिखर जाता है। कुछ और भी कठिनाइयां आईं। उदाहरण के लिए उड़ीसा में मैदानी इलाकों में ग्राम पंचायतें आमतौर पर पन्द्रह या अधिक बसावटों की जिम्मेदारी उठाती है। इससे काम थोड़ा ज्यादा ही फैल जाता है और उसका फोकस कुछ खास परिवारों पर केंद्रित नहीं रह पाता। अगर एक–दो बसावटों पर ध्यान देना पड़े तो ध्यान अधिक गहरा दिया जा सकता है और ऊर्जा–प्रणालियों के निर्माण से लेकर रख–रखाव तक का काम अच्छा चलता है। इसीलिए 'ग्राम विकास' ने अपनी रणनीति बदली और पंचायत की बजाय ग्राम–सभाओं या 'पल्ली सभाओं' को इस काम से जोड़ना शुरू किया। इससे गैर–जरूरी फैलाव कम हुआ और फोकस केवल एक गांव के परिवारों तक सीमित होने स ज्यादा गहराई से काम होने लगा। इसमें लिंगभेद का ध्यान रखने यानी महिलाओं को प्राथमिकता देने में और सामुदायिक स्वामित्व तय करने में भी आसानी हुई।

जैसा हमने पानी की आपूर्ति और स्वच्छता के कार्यक्रमों में किया था, वही दृष्टिकोण ऊर्जा प्रणालियों में भी अपनाया गया। यानी कि बायोगैस हो या पनबिजली उसके काम में पूरे गांव को शामिल किया और उनमें आपसी सहयोग को और मिल–जुलकर प्रबंध करने की भावना को प्रोत्साहित किया। उनको प्रोत्साहित करने के साथ–साथ उनका सशक्तीकरण भी किया गया, ताकि उनमें यह भरोसा पैदा हो कि वे ये सारी जिम्मेदारी अपने बूते ही निभा सकते हैं, नियंत्रण कर सकते हैं और वित्तीय तथा प्रबंधकीय उत्तरदायित्व भी उठा सकते हैं।

हम दूर–दराज के देहाती इलाकों में काम करते हैं। इसलिए हमने यह ध्यान भी रखा कि आसपास की बसावटों के बीच ध्यान केन्द्रित रखा जाए, ताकि स्थानीय अर्थव्यवस्था प्रभावित हो और उसे लाभ मिले। साथ ही स्थानीय तौर पर उपलब्ध प्रतिभा को ही रख–रखाव और मरम्मत वगैरह के काम में लगाया जाए।

प्रौद्योगिकियां

अपारंपरिक ऊर्जा–स्रोत मंत्रालय ने बायोमास पर आधारित ऊर्जा–प्रणालियों को ग्रामीण ऊर्जा सुरक्षा का प्राथमिक स्रोत घोषित किया है। इसको कार्यान्वित करते हुए 'ग्राम विकास' ने बायोगैस, बायोमास–गैसीफायर और बायोडीजल के कार्यक्रम संचालित किए हैं। बायोगैस दोनों तरह के बनाए गए हैं – गोबर–गैस वाले भी और कूड़ा–कर्कट व कृषि छीजन वाले भी। इसी तरह, लकड़ी और चारकोल पर आधार गैस–इंजन बनाए गए हैं। इसके साथ ही पनबिजली की अनेक लघु योजनाएं भी लागू की गई हैं। कहां क्या करना है इसका चयन स्थानीय लोगों के साथ विचार–विमर्श करके स्थानीय रूप में उपलब्ध संसाधनों के आधार पर किया जाता है। अब हम अपने अक्षय–ऊर्जा कार्यक्रम में सौर–ऊर्जा भी जोड़ रहे हैं, खासतौर से पानी पम्प करने के लिए।

इसके लिए हमने जो गांव चुने हैं वे मुख्यतः आदिवासियों के हैं और वहां बिजली नहीं पहुंची है और वे दूर–दराज के इलाकों में स्थित हैं। हमने बिजली पैदा करने के लिए अक्षय–ऊर्जा–प्रणालियों पर आधारित जो संयंत्र लगाए हैं, वे देहाती इलाकों की जरूरतों के अनुसार 3 से 20 किलोवाट तक के ही हैं। वे गांवों और आसपास के लोगों के लिए बड़े काम के साबित हुए हैं। इनसे इतनी बिजली मिल जाती है जो घरेलू जरूरतें पूरी कर सके और साथ ही कुटीर उद्योग–धंधे भी चला सके। जहां जरूरत हुई है वहां पेयजल उपलब्ध कराने के लिए पानी के पम्पों को भी बिजली दी गई है। सुधरे चूल्हे लगाकर रसोई में स्वच्छता बढ़ाई गई है और घरों में स्वास्थ्य को हानि पहुंचाने वाला धुंआ बेहद कम कर दिया गया है। ईंधन की खपत में भी कमी आई है और बच्चों तथा महिलाओं के स्वास्थ्य में सुधार होने से वे अधिक उत्पादक जीवन बिता पा रहे हैं। अब महिलाओं को जलाऊ ईंधन इकट्ठा करने के लिए पूरे–पूरे दिन जहां–तहां नहीं भटकना पड़ता। बायोगैस–कार्यक्रम से भी इसी तरह के फायदे हुए हैं। हमने अपने कार्यक्रम में शुरू से ही इसका ख्याल रखा है कि प्रौद्योगिकी पर से रहस्य का परदा

उठायें और उसे इस्तेमाल करने वालों के मन में से उसका आतंक निकल जाए। रख–रखाव और मरम्मत के काम को प्रशिक्षण गांव में से ही चुने गए व्यक्तियों को दिया गया है, जिनमें महिलाएं भी शामिल हैं। डिजाइन भी ऐसी चुनी जाती है कि उसमें आगे चलकर कोई खास कठिनाई न आए और वह अधिक से अधिक समय तक समस्याहीन सेवा देती रहे।

सामुदायिक प्रक्रियाएं

चाहे सुधरे चूल्हे हों, बायोगैस–संयंत्र हों, लघु–पनबिजली–इकाइयां हों, गैसीफायरों के लिए बायोमास उपलब्ध करने के लिए वृक्षारोपण के कार्यक्रम हों, या बायोडीजल संयंत्र हों, सबमें ग्राम वासी अपनी पूंजी लगाते हैं और अपना श्रम भी लगाते हैं और कच्चा माल भी यथा संभव जुटाते हैं। इन प्रणालियों पर मालिकाना हक भी उन्हीं का होता है, इसलिए गांववालों को इन्हें अपनाने के लिए प्रेरित करने में कोई खास मेहनत नहीं करनी पड़ती, हालांकि शुरू में इन कार्यक्रमों की और इनसे होने वाले फायदों के बारे में पूरी जानकारी देकर उनका भरोसा जीतना बहुत जरूरी है। हर घर के हर परिवार को शत–प्रतिशत प्रतिबद्ध होना होता है, तभी शत–प्रतिशत सफलता मिल सकती है। इसीलिए हर परिवार से चंदा उगाहने के बाद एक कोर्पस फंड बनाया जाता है। प्रत्येक घर से एक महिला और एक पुरुष को सदस्य बनाकर गांव में 'विलेज जनरल बॉडी' (वीजीबी) की स्थापना की जाती है। उन्हें मत देने का अधिकार होता है और वे ही सम्पूर्ण कार्य का प्रबंधन करते हैं। कोर्पस फंड को 'वीजीबी' के द्वारा चलाए गए प्रचार–प्रसार के कामों के लिए आरक्षित कर दिया जाता है और एक बार प्रशिक्षण और जानकारी देकर सशक्त बना देने के बाद 'वीजीबी' से आशा की जाती है कि वह सभी प्रणालियों को सुचारू रूप से चलाने की जिम्मेदारी पूरी लगन से निभाएगी। आगे चलकर यही संस्था गांव में विकास के दूसरे कामों को अंजाम देने लायक अनुभव और योग्यता प्राप्त कर लेती है।

इन लोगों को उन जगहों पर ले जाकर अक्षय–ऊर्जा के साधन दिखाए जाते हैं, जहां पर ये प्रणालियां पहले से लगी हैं और काम कर रही हैं। इसके साथ ही तकनीकी और प्रबंधन कर प्रशिक्षण भी दिया गया, ताकि वे अपनी ऊर्जा–प्रणालियों का रख–रखाव और प्रबंधन अपने आप कर सकें और उन्हें अपना ही समझें। इसी तरह स्थानीय महिलाओं को धुंआविहीन चूल्हे बनाने का प्रशिक्षण दिया गया, ताकि वे इनको बनाकर और रख–रखाव की जिम्मेदारी लेकर अपनी आमदनी बढ़ा सकें। हमने इन लोगों को अपने प्राकृतिक संसाधनों का सर्वेक्षण करना भी सिखाया और इस तरह इकट्ठे किए गए आंकड़ों का विश्लेषण करके अपने पर्यावरण को ठीक तरह से समझने और उसे उत्पादक रूप में इस्तेमाल करने तथा उसका संरक्षण करने की भी सीख दी।

वित्तीय व्यवस्था

हमने फिलहाल इन कार्यक्रमों का खर्चा उठाने के लिए द्विपक्षीय भागीदारी से वित्तीय साधन जुटाए हैं, क्योंकि सरकारी अनुदान लेने में लंबी कागजी कार्रवाई के कारण तथा अन्य कारणों से काफी कठिनाई आती है। हमने आरवीई कार्यक्रम के लिए 'वीईएसपी' आते ही डीपीआर दाखिल कर दिए थे और सभी प्रस्ताव वीईएसपी की मार्गदर्शिका के अनुसार बनाए गए थे। हमने इसमें काफी मेहनत की थी, लेकिन स्थानीय बिजली वितरण कंपनियों से 'नॉन–इलैक्ट्रीफिकेशन सर्टिफिकेट' लेना मुश्किल हो गया। हुआ यह था कि इधर मंत्रालय का यह कार्यक्रम आया उधर कंपनियों को ग्रिड का विस्तार करने के लिए फंड मिल गए। बस फिर क्या था कागज पर ही सही बहुत–से उन गांवों में भी बिजली पहुंच गई जिन्होंने कभी एक लट्टू के भी दर्शन नहीं किए थे।

हमने जिन गांवों के लिए अक्षय–ऊर्जा प्रणली स्थापित करने के प्रस्ताव भेजे थे, उनमें से एक गांव को, जिसमें 35 घर थे, बहुत छोटा बताया गया। अब कौन समझाये कि उड़ीसा में ऐसे गांव सबसे ज्यादा हैं, जिनमें बिजली नहीं पहुंची और ऐसे अधिकतर गांव दूर–दराज के इलाके में स्थित हैं। खासतौर से आदिवासी इलाकों में। इस तरह के अधिकतर गांवों का औसत आकार 30–40 घरों के बीच का ही है।

एक और बात यह देखी गई कि मंत्रालय के 'विलेज सिक्योरिटी प्रोग्राम' में यह तो अच्छी बात है कि उसका दृष्टिकोण सर्वांगीण है, लेकिन शुरूआती खर्चा तो उठाया जा सकता है, इतने अनुदान में बाद में कार्यक्रम जारी रख्ने में दिक्कत आती है। 100 घर वाले गांव के लिए 20 लाख रुपये दिए जाते हैं। इससे काम शुरू तो किया जा सकता है, लेकिन रख–रखाव और मरम्मत तथा देखभाल के लिए कुछ नहीं बचता। यह बात उस राष्ट्रीय कार्यशाला में भी उभरकर आई, जो ग्राम विकास ने टेरी (द एनर्जी रिसोर्स इन्स्टीट्यूट) के साथ मिलकर नवम्बर 2004 में आयोजित की थी। इसमें 'दूरस्थ गांवों के विद्युतीकरण और ग्रामीण ऊर्जा सुरक्षा' पर चर्चा की गई थी। इसका आयोजन दक्षिण उड़ीसा में बहरामपुर के निकट के कैम्पस में किया गया था। इसमें कर्नाटक, उत्तरांचल, पश्चिम बंगाल, छत्तीसगढ़ और उड़ीसा से पधारे 70 से अधिक

प्रतिनिधियों ने भाग लिया। इसका प्रायोजक एमएनईएस ही था। इसमें सबसे अच्छी बात यह थी कि इन सभी राज्यों के अलावा भी लगभग पूरे देश से ग्रामीण नेता पधारे थे जिन्होंने गांव में ऊर्जा का ढांचा खड़ा करने, चलाने और रख–रखाव करने की जिम्मेदारी निभाई थी। इसलिए एक–दूसरे के खट्टे–मीठे अनुभव सुनने को मिले कि गांवों में ऊर्जा–सुरक्षा सुनिश्चित करने के मार्ग में क्या–क्या बाधाएं आती हैं और अब भी आ रही हैं। सबसे अधिक यह बात उभरकर आई कि 'ग्राम–आधारित सामुदायिक स्वामित्व वाली ऊर्जा–प्रणलियां बड़ी जटिलता पैदा करती हैं और उनमें काफी समय, श्रम और पूंजी लगती है और हर समुदाय से कुछ न कुछ नया सीखने–समझने और निपटने को मिलता है और इस सबमें बाहरी एजेंसी को काफी रवटना पड़ता है।''

फिर यह एजेंसी 'ग्राम विकास' जैसी स्वैच्छिक संस्था हो सकती है, पंचायत हो सकती है या राज्य की नोडल एजेंसी हो सकती है या ग्रामीण समुदाय हो सकता है। इस प्रक्रिया में फंड काफी खर्च होता है और ग्रामीण ऊर्जा–सुरक्षा कार्यक्रम का टिकाऊपन बनाए रखना बड़ा मुश्किल होता है।

दूर–दराज के गांव वालों से हम शहर वाले यह उम्मीद करते हैं, खासतौर से वे सरकारी अधिकारी जिन्हें ग्रामीण जीवन की कठिनाइयों का कोई खास अनुभव नीं है और जिन्होंने गांव बस रुपहले परदे पर देखे हैं, कि अपनी बुनियादी सेवाओं के लिए गांव के लोग खुद खर्चा करें और वह भी नगरीय सेवाओं के मुकाबल बहुत–ज्यादा। उदाहरण के लिए शहर में राष्ट्रीय ग्रिड से बिजली मिलती है, जो बहुत सस्ती पड़ती है, जबकि अक्षय–ऊर्जा कालांतर में भले ही सस्ती पड़े, शुरू में स्थापित करने में तो काफी खर्चा आता है और स्थानीय रूप से रख–रखाव करने वाले कुशल व्यक्ति तैयार करने होते हैं। जबकि बिजली विभाग प्रशिक्षित इंजीनियरों और तकनीकी कर्मचारियों के बूते या कंपनियों के कुशल कर्मियों के बूते बिजली पैदा करने और वितरित करने का काम करते हैं, जिन्हें अच्छे वेतन और सुविधाएं मिलती हैं। दूर–दराज के गांव एक–दूसरे से अलग–थलग पड़े हैं। सदियों के अंधरे ने उनमें तमाम रूढ़ियां पैदा कर दी हैं। उनके सामने ऊर्जा की समस्या ही नहीं, वे गरीबी और भूख से और बीमारी से भी लड़ रहे हैं। अशिक्षा का अंधकार इस तमस को और भी बढ़ा देता है। जीविका के साधन विरल हैं। हर तरह की असुरक्षा है। इनसे यह उम्मीद करना कि वे अक्षय–ऊर्जा प्रणालियों का तकनीकी और वित्तीय दायित्व उठा लेंगे, बड़ी दूर की कौड़ी है। फिर भी ग्राम विकास ने इस दिशा में बाधाओं के बावजूद काफी हद तक सफलता पाई और गांव वालों से भी बहुत कुछ सीखा और इसी काम में दूसरी जगहों पर जुटी स्वैच्छिक संस्थाओं के अनुभवों से भी बहुत–से उपयोगी सबक मिले।

रूपांतर : डॉ. अनुराग शर्मा

ऊर्जा-जगत

डॉ. रमेश दत्त शर्मा *

राष्ट्रपति ने अक्षय ऊर्जा पर बल दिया

28 फरवरी 2006 को राष्ट्रीय विज्ञान दिवस पर राष्ट्र के नाम प्रसारित संदेश में माननीय राष्ट्रपति डॉ. ए.पी.जे.अब्दुल कलाम ने मुख्य रूप से ऊर्जा की समस्या की ओर देश का ध्यान खीचा। उन्होंने अपने अभिभाषण में अक्षय ऊर्जा अपनाने पर विशेष बल दिया। यहा हम अक्षय ऊर्जा वाले अंश का सार–संक्षेप दे रहे हैं :

''सन् 2030 तक ऊर्जा में आत्मनिर्भरता के लिए मैंने मिशन के रूप में अनुसंधान के लिए चार क्षेत्र चुने हैं, जिन पर हमारे वैज्ञानिकों को विशेष ध्यान देना होगाः

- उच्च दक्षता के लिए सीएनटी (कार्बन नैनोट्यूब) पर आधारित सोलर सैलों का विकास;
- जैव ईंधन के लिए अधिक तेलांश वाली किस्में विकसित करना;
- हाइड्रोजन ईंधन का सक्षम पॉवर पैकेज बनाना।''
- सीएनटी पर आधारित सोलर सैलों का विकास

सन् 2030 तक अक्षय–ऊर्जा के उपयोग की वर्तमान दर को 5% से बढ़ाकर 25% तक ले जाना होगा। इसमें सौर–ऊर्जा की प्रमुख भूमिका होगी। वर्तमान फोटोवोल्टेइक सैलों (पीवीसी) की कम दक्षता को गैलियम आर्सेनाइड (जीएएएस) और सीएमए पर आधारित मल्टीजंक्शन युक्ति बनाकर 30% तक बढ़ाया जा सकता है। सीएनटी सोलर सैलों की सतह पर उच्च विद्युत धारा घनत्व क्षमता प्रदान करके अपने अक्ष पर उच्च बैलिस्टिक ट्रांसपोर्ट प्रोपर्टी प्रदान कर सकते हैं जिसमें ऊर्जा की हानि कम होगी। वे यह क्षमता 35% तक बढ़ा सकते हैं। लेकिन नए अनुसंधानों से पता चला है कि इसे और भी बढ़ाया जा सकता है। इसके लिए 'एलाइंड सीएनटी आधारित पीवीसैल बनाने होंगे जो पोलीमर कंपोजिट होंगे। इससे आवेश का ऊर्जा में रूपांतरण अच्छा होगा। प्रयोगशाला में सीएनटी–पोलीमर कंपोजिट सोलर सैलों की दक्षता 50% तक बढ़ाई जा चुकी है, जो अगले तीन सालों में बड़े पैमाने पर योग्य बनाई जा सकती है। पांच सालों में ऐसे सोलर सैलों का व्यापारिक उत्पादन शुरू हो सकता है। इसी प्रकार जैव सोलर सैल, डाई–सेंसिटाइज़्ड सोलर सैल तथा तीसरी पीढ़ी के सोलर सैल भी बनाये जाने चाहिए।

* *457, हवा सिंह ब्लॉक, खेल गांव, नई दिल्ली–110049*

जैव ईंधन के लिए अधिक तेलांश वाली किस्में विकसित करना

हमारे देश में लगभग 6 करोड़ हैक्टर बंजर जमीन है, जिसमें से 3 करोड़ हैक्टर जमीन में ऊर्जादायक वृक्षारोपण किया जा सकता है। यहां रतनजोत की सुधरी किस्में और अन्य पौधे उगाए जा सकते हैं। एक बार उगाने पर रतनजोत की फसल 50 सालों तक चलेगी। अभी अधिकतम 10% तक जैव–ईंधन मिलाकर बायोडीजल बनाने की सरकार ने अनुमति दी है। रतनजोत से बायोडीजल बनाने की लागत 20 रुपये प्रति लिटर बैठती है। भारी वाहनों और ट्रैक्टरों में तो शतप्रतिशत बायोडीजल इस्तेमाल करने के अच्छे नतीजे मिले हैं। बायोडीजल से कार्बन बिल्कुल नहीं निकलता और अनेक उपोत्पाद भी मिल सकते हैं। इसके लिए गहन अनुसंधान की आवश्यकता है। भारतीय रेलवे ने तमिलनाडु में वंजावुर से नागौर, तिरुचुर पल्ली से लालगुडी और डिंडोगुल से करूर एस्टरीकरण तक दो पैसंजर लोकोमोटिवों से छह रेलगाड़ियां बायोडीजल के इस्तेमाल से चलाई हैं इसके लिए 5% बायोडीजल मिलाया गया, जो अपने ही एस्टरीकरण संयंत्रों में बनाया गया था। रेलवे लाइनों के आसपास और दूसरी जमीनों में रेल मंत्रालय ने रतनजोत के डेढ़ करोड़ पौधे लगाए गए थे जो इस साल सन् 2006 से बीज पैदा करने लगेंगे। छत्तीसगढ़, मिजोरम, तमिलनाडु और आन्ध्र प्रदेश में बड़े पैमाने पर रतनजोत की फसल उगाई गई है। रतनजोत की ऐसी सुधरी किस्में बनाने की जरूरत है जो दो टन प्रति हैक्टर बीज पैदा करें। अधिकतर किस्मों में तेलांश 25 से 35% तक होता है। सुधरी किस्में विकसित करके यह तेलांश 45% तक बढ़ाया जा सकता है। इनसे 35% तक तेल निकाला जा सकेगा प्रति पौधा 4 से 6 किलोग्राम बीज पैदा करने वाली किस्में प्रतिवर्ष 4 से 6 टन प्रति हैक्टर बीज पैदा कर सकेंगीं। ये किस्में कम से कम नमी में भी फूल और फल पैदा कर सकें तो अच्छा होगा, ताकि कुल उत्पादकता बढ़े। साथ ही अधिक दक्ष इंजन भी बनाने पड़ेंगे, जो जैवईंधन को पूरी तरह जलाएं।

हाइड्रोजन ईंधन के सक्षम पॉवर पैकेज बनाना

जब मैं आइसलैंड गया, तो मैंने वहां के राष्ट्रपति के साथ जिस बस में यात्रा की वह हाइड्रोजन के ईंधन से चल रही थी। हम हाइड्रोजन भरने वाले फ्यूअल स्टेशन पर भी गए और बस की टंकी में हाइड्रोजन गैस भरवाई। मुझे ध्यान है कि अपने देश में हाइड्रोजन गैस से मोटरसाइकिल, तिपहिया और छोटे जेनरेटर सफलतापूर्वक चलाए गए हैं। इसके अतिरिक्त पीईएमएफसी–पोलीमर इलैक्ट्रोलाइट मेम्ब्रेन फ्यूअल सैल और पीएएफसी–फोस्फोरिक एसिड फ्यूअल सैल भी विकसित किए गए हैं। फ्यूल–सैल–बैटरी हाइब्रिड वैन भी चलाई गई है। डिस्टिलरी के छीजन से हाइड्रोजन बनाने और अन्य अक्षय ऊर्जा संबंधी साधन भी विकसित किए गए हैं। हाइड्रोजन गैस को धातुओं के हाइड्राइडों में भरकर रखा जा सकता है। यह प्रदर्शित किया जा चुका है। इस समय इस दिशा में अनेक अनुसंधान–प्रयास जारी हैं। दुनिया में फ्यूअल सैलों से चलने वाले वाहन वास्तविकता में बदलने वाले हैं। भारत में डीआरडीओ के साथ मिलकर एक बिजली–कार कंपनी ने फ्यूअल सैल पर चलने वाला 'संकर वाहन' बनाया है जिसमें ईंधन की लागत मात्र 40 पैसे प्रति किलोमीटर आती है और कार को बिना प्रदूषण पैदा किए चलाया जा सकता है। इसरो के रॉकेटों में भी तरल ऑक्सीजन और हाइड्रोजन ईंधन इस्तेमाल किया जा रहा है। महेन्द्रगिरि स्पेस सेंटर में हाइड्रोजन ईंधन बनाया जा रहा है। अब हाइड्रोजन को उच्च दाब पर भंडारित करने, तरल–भंडारण, नैनो–संरचनाओं में भंडारित करने, सुरक्षा के कोड बनाने, मानक बनाने और उपयुक्त इंजन बनाने पर ध्यान देना होगा।

विज्ञान प्रौद्योगिकी को जन्म देता है। प्रौद्योगिकी उत्पादों को जन्म देती है। हमारे वैज्ञानिकों, खासतौर से युग वैज्ञानिकों को इस ओर ध्यान देना होगा कि वे हमारी एक अरब से अधिक जनसंख्या के लिए मिशन के रूप में ऐसे लागत–लाभकारी उत्पाद विकसित करें जो उनका जीवन–स्तर ऊंचा उठायें। उनकी वैज्ञानिक खोजों पर ही भावी भारत की बुनियाद रखी जाएगी।

प्रयोगशाला में सूर्योदय

हमारी पृथ्वी पर ऊर्जा के अजस्र स्रोत का सर्जक सूर्य ही है। इसीलिए भारतीय संस्कृति में सूर्य को प्रातःकाल ही अर्घ्य चढ़ाकर वंदना करने का विधान है। सूर्य की ऊर्जा ही प्रकाशसंश्लेषण की क्रिया से हरे पौधों द्वारा लकड़ी, कंद–मूल–फल, सब्जी, अनाज, तिलहन, दलहन, रेशा, चीनी, खाने के तेल, आदि में बदली जाती है। यही हम सब की जठराग्नि बुझाती है। लकड़ी ही लाखों वर्ष दबी रहकर पीट, कोयला, मिट्टी का तेल (केरासिन), डीजल, पेट्रोल और अन्य पेट्रोलियम–पदार्थ बनाती है। इसी ऊर्जा से यह सब कुछ चलायमान है। पवन इसी की गर्मी से चलकर पवन–ऊर्जा प्रदान करता है। पानी इसी की ऊर्जा से गर्म होकर भाप बनता है, बादल बनते हैं, वर्षा होती है। सूर्य की धूप को सोखकर ही सोलर सैल बिजली में बदलते हैं यही ऊर्जा बायोमास के रूप में जलाई जाती है और उससे बिजली बनती है।

सूर्य पृथ्वी के व्यास से 100 गुना बड़ा है। इसके अंदर पृथ्वी के आकार के एक करोड़ ग्रह समा सकते हैं। पृथ्वी से सूर्य की औसत दूरी 15 करोड़ कि.मी. है। सूर्य की सतह का हर वर्ग इंच (6.4 सें.मी.^{2}) 15 लाख मोमबत्तियों के बराबर रोशनी देता है। सूर्य से हम जितना प्रकाश पाते हैं, उसके लिए मोमबत्तियां केक पर जलाएं तो उस केक का घेरा 965 कि.मी. होगा। सूर्य अब से लगभग साढ़े चार पांच अरब साल पहले पैदा हुआ था और अभी कम से कम 5 अरब साल तक ऊर्जायमान रहेगा। हाइड्रोजन के दो परमाणु का संलयन (फ्यूजन) होता है और उसी से सूर्य के अंदर हीलियम बनता है, जो सूर्य की ऊर्जा का अजस्र स्रोत है।

अब पृथ्वी पर ही प्रयोगशाला में सूर्य की इस अभिक्रिया को दुहराया गया है, यह दावा एक भारतीय आप्रवासी वैज्ञानिक ने किया है। कोई अन्य वैज्ञानिक 'साइंस' पत्रिका में प्रकाशित इस शोध को अभी दुहरा नहीं पाया, इसलिए अभी इस महान वैज्ञानिक उपलब्धि पर विवाद की छाया मंडरा रही है।

डॉ. रूसी.पी.तल्यार खां ने सूर्य के भीतर चलने वाली संलयन की अभिक्रिया प्रयोगशाला में दुहराने का दावा पहले–पहल सन् 2000 में 'साइंस' में प्रकाशित शोध पत्र में किया था। प्रयोग में एक तरल विलायक के अंदर अत्यंत प्रबल पराध्वनिक (अल्ट्रासोनिक) कंपनों से विस्फोट किया, जिसके कारण तरल पदार्थ में गैस के बारीक बुलबुले लाखों डिग्री सेल्सियस तक गरम हो गए, लेकिन सूर्य की तुलना में यह 'कोल्ड फ्यूजन' कहा गया और संलयन की जो प्रक्रिया समपन्न हुई, उसे 'सीनोफ्यूजन' या 'बबल फ्यूजन' कहा गया। इसका पता उन न्यूट्रोनों से चला जो इसके बाद 'डिटेक्टर' में पहचाने गए। उस समय डॉ. तल्यार खां ओकरिज नेशनल लेबोरेटरी, टेनेसी में काम करते थे। सन् 2003 में वे पर्दू यूनिवर्सिटी में न्यूक्लियर इंजीनियरिंग के प्रोफेसर नियुक्त हो गए। यहां उनके दो सहयोगियों ने उनके साथ मिलकर भौतिकी के प्रमुख जर्नलों

में दो और शोध पत्र प्रकाशित किए। कैलीफोर्निया यूनिवर्सिटी, लॉस एंजल्स के शोधकर्ता ब्रिआन नारान्जो ने डॉ. तल्यार खां के पिछले शोधपत्र के विश्लेषण से बताया कि जिस प्रकार के कण पैदा हुए वे संलयन से पैदा हुए हों, इसकी संभावना '100 लाख में एक बार' की है। अमरीकी रक्षा विभाग से प्राप्त 350,000 डालर की सहायता से नारान्जो की थीसिस के एडवाइजर तथा भौतिकी के प्रोफेसर डॉ. सेठ जे.पुटरमैन ने डॉ. तल्यार खां से उनके परिकलन (कैलकूलेशन) पूछे तो वे कोई संतोषजनक उत्तर नहीं दे पाए। आशंका यह है कि उनके डिटेक्टर में पहुंचे न्यूट्रोन जहां प्रयोग किए गए थे, वहीं 15 फुट पास में रखे 'कैलीफोर्नियम' नामक रेडियोएक्टिव तत्व से निकले होंगे।

संलयन का पहला प्रयोग मार्च 1989 में किया गया था और फीश्चमान–पोंस प्रयोग के नाम से मशहूर है। लेकिन वह भी विवादों में फंस गया था। परमाण–विखण्डन से लाखों डिग्री सेल्सियस कम तापमान पर हाइड्रोजन के आइसोटोप, ड्यूटेरियम के परमाणुओं का संलयन करने की संभावना पर काफी समय से अनेक प्रयोगशालाओं में काम चल रहा है। इससे ऊर्जा तो बहुत पैदा होगी और छीजन बहुत कम। लेकिन खर्चा बहुत आता है।

6 दिसम्बर 2005 से संलयन–ऊर्जा के एक अंतर्राष्ट्रीय प्रयोग में भारत को भी ाामिल किया गया है। यह है आईटीईआर–'इण्टरनेशनल थर्मोन्यूक्लियर एनर्जी रिएक्टर'। इसमें अमरीका और यूरोपी संघ के सदस्य देशों के अतिरिक्त रूस, चीन, जापान, दक्षिण कोरिया और भारत के वैज्ञानिक भाग ले रहे हैं। यूरोपी संघ इसका 45 प्रतिशत खर्च उठाएगा और बाकी छह देश नौ–नौ प्रतिशत। जापान में तोक्यो के पास नाका में और जर्मनी में म्यूनिख के पास गार्चिंग में दो स्थानों पर विशेष संयुक्त प्रयोगशालाएं बन रही हैं। असली काम फ्रांस में कडार्श में बन रहे 'आईटीईआर' में चलेगा। 'आइटर' लैटिन शब्द है जिसका अर्थ होता है 'मार्ग'। यह हाइड्रोजन प्लाज्मा टोरस पर आधारित है और 1000 लाख डिग्री सेल्सियस पर 500 मेगावाट फ्यूजन पॉवर पैदा करेगा। सन् 2016 तक मुख्य प्रयोगशाला प्लाज्मा–भौतिकी के इस विशाल प्रयोग को शुरू कर देगी। 20 सालों में इस पर 37600 लाख डालर खर्च होने का अनुमान है।

एक और वैज्ञानिक डॉ. क्रिस डोने ने सांडिया नेशनल लेबोरेटरीज में एक पार्टीकल एक्सीलरेटर में कणों को 2 अरब केल्विन तक गर्म करने का दावा किया है। यह सूर्य या किसी भी अन्य तारे के गर्भ में मौजूद तापमान से अधिक है और इसने अब तक पैदा हुए ऊंचे तापमान के सारे रिकार्ड तोड़ दिए हैं। इससे भविष्य में सस्ते नाभिकीय संलयन–संयंत्र बनाकर सस्ती और प्रदूषण रहित बिजली पैदा करने का मार्ग प्रशस्त हुआ है। स्वयं प्रयोगकर्ताओं को तभी विश्वास हुआ, जब उन्होंने यह प्रयोग कई बार दुहरा लिया। 14 महीनों तक तो प्रयोग के परिणाम कंप्यूटर में ही भरे रहे। ये परिणाम 24 फरवरी 2006 के 'फिजीकल रिव्यू लैटर्स' में प्रकाशित किए गए हैं

चीन की विज्ञान अकादमी ने सन् 1991 से समुद्र के पानी से ड्यूटेरियम अलग करके उसके संलयन से असीमित ऊर्जा प्राप्त करने का कार्यक्रम शुरू किया था। इसके लिए पहले प्लाज्मा भौतिकी संस्थान ने महा सुचालक टोकामैक उपकरण 'एचटी–7' बनाया। सन् 2000 से इसका सुधरा रूप बनाना शुरू किया। अब उनका दावा है कि इस साल वे नाभिकीय संलयन से बिजली बनाना शुरू कर देंगे, क्योंकि ईएएटी (ईस्ट) यानी 'एक्सपेरीमेंटल एंडवांस्ड सुपरकंडक्टिंग टोकामैक' चीन में अप्रैल 2006 से काम करने लगेगा। इस चीनी दावे पर अभी वैज्ञानिकों को यकीन नहीं आ रहा।

अति सूक्ष्म उपकरणों को ऊर्जा देगा 'नैनोस्किन'

न्यूयार्क रेंसेलोर पोलीटेक्निक इन्स्टीट्यूट में 'मैटीरियल साइंस एंड इंजीनियरिंग साइंस' के हेनरी बर्लाग प्रोफेसर पुलिकेल अजयन ने एक नया प्रक्रम इस्तेमाल करके बेहद लचीला 'नैनोस्किन' बनाया है। उनका शोध पत्र 'नैनोलैटर्स' के मार्च 2006 के अंक में प्रकाशित हुआ है। यह 'नैनोट्यूब' और 'पोलीमरों' के मिश्रण से बनाया गया है। पहले ये प्रयास असफल रहे थे क्योंकि नैनोट्यूबों का अपना विन्यास बिगड़ जाता था। इस 'नैनोस्किन' को कागज की तरह समेटा जा सकता है। ये बिजली का सुचालक है। ये इलैक्ट्रोनिक पेपर और इलैक्ट्रोनिकी के बारीक उपकरणों को ऊर्जा प्रदान कर सकता है। इससे अतिलघु प्रेसर सेंसर और गैस डिटेक्टर बनाने और इस तरह रासायनिक और जैव पदार्थों की मामूली–से–मामूली मौजूदगी पहचानने में मदद मिलेगी। ये 'नैनोट्यूब' को किसी भी 'प्लेटफार्म' पर 'ट्रांसफर' करने का पहला सफल प्रयोग माना जा रहा है।

पवन–ऊर्जा जलाएगी आज़ादी की मद्दाल

अमरीका में समुद्रतट पर अभ्यागतों का स्वागत करती विशाल स्वतंत्रता की देवी की मूर्ति की मशाल अब पवन–ऊर्जा से प्राप्त बिजली से जलेगी। इसका तीन साल का ठेका 'पेप्को एनर्जी सर्विसेज' को मिला है। इसके लिए बिजली

पेनसिल्वानिया और न्यूयार्क के विण्डफार्मों से दी जाएगी। 'लिबर्टी' के इस स्टेचू का सन् 1886 में उद्घाटन किया गया था और इसे फ्रांस ने दान में दिया था। जब सन् 2003 में उत्तर–पूर्वी अमरीका बिजली गुल होने से अंधेरे में डूब गया था तो भी जेनरेटरों के बल पर आजादी की यह मशाल जलती रही थी। असल में राष्ट्रपति बुश के चुनाव–विशेषज्ञों ने उन्हें अपनी तेल–प्रेमी की छवि सुधारने की सलाह दी है। इसीलिए सन् 2007 के बजट में अमरीका ने अक्षय ऊर्जा के लिए पहले से 22 प्रतिशत अधिक वित्तीय प्रावधान की घोषणा की है। हालांकि वहां के नेशनल एन्वायरनमेंटल ट्रस्ट के अध्यक्ष फिलिप क्लाप का कहना है कि अभी तक घोषित अक्षय ऊर्जा के आधे कार्यक्रमों के लिए बुश–प्रशासन ने कोई फंड रिलीज नहीं किया। पवन–ऊर्जा से एलिस द्वीप पर बनी विशाल मशाल को 270 लाख किलोवाट ऑवर हरी ऊर्जा मिलेगी।

स्वीडन बनेगा पहला तेल-मुक्त देश

विकसित देशों में से स्वीडन पहला देश बन गया है, जिसने सन् 2020 तक तेल मुक्त होने का संकल्प किया है। वह अपनी ऊर्जा की सारी जरूरतें अगले 15 सालों में जैवईंधन और पवन–ऊर्जा जैसे अक्षय ऊर्जा के साधनों से ही पूरी कर लेगा। उसका यह भी मानना है कि इस तरह वह अक्षय–ऊर्जा के साधनों के व्यापार में भी सबसे आगे पहुंच सकेगा। क्योंकि आगे ग्रीन हाउस गैसों का उत्सर्जन कम करने का दबाव पूरी दुनिया के देशों पर बढ़ेगा और वे अधिकाधिक अक्षय–ऊर्जा इस्तेमाल करने लगेंगे। स्वीडन के निवासियों में भी अक्षय–ऊर्जा को अपनाने के लिए अपार उत्साह है। हजारों घरों में सेण्ट्रल हीटिंग के लिए अब बायोपैलट जलाकर बॉयलर चलाए जाते हैं और तेल की छुट्टी कर दी है। जैव ईंधन से चल रही एक विशाल भट्टी स्वीडन ही नहीं पास के पड़ौसी देशों के परिवारों की भी गरम पानी की आपूर्ति कर रही है। गर्म करने के लिए पहले स्वीडन में जितना पेट्रोल फूंका जाता था, उसमें 85 प्रतिशत की कमी आ गई है।

भारत तापनाभिकीय संलयन पर अनुसंधान में पीछे नहीं

भारत भी संलयन–ऊर्जा पर अनुसंधान में पीछे नहीं है और सन् 1989 में इसके लिए 'आदित्य' नाम से एक संयंत्र बनाया गया था। अब एक सुधरा संयंत्र बनाया गया है, जिसकी डिजाइन 'ईटर संयंत्र' जैसी ही है। गांधी नगर में स्थित इन्स्टीट्यूट ऑफ प्लाज्मा रिसर्च के निदेशक डॉ. पी.के. काव के अनुसार अंतर्राष्ट्रीय ईटर परियोजना में शामिल होने पर भारत कोई बीस साल बचा लेगा यानी सन् 2050 की बजाय सन् 2030 में संलयन–ऊर्जा से भारत में बिजली बनने लगेगी। भारत अपना नया संयंत्र 'स्टेडी स्टेट सुपरकंडक्टिंग टोकामैक' चालू करने के लिए पिछले आठ साल से काम कर रहा है। आदित्य में प्लाज्मा एक सेकंड के कुछ हिस्से तक ही रह पाता था। नए रिएक्टर में 1000 सेकंड तक रहेगा। प्लाज्मा गैस का विद्युत आवेशित रूप होता है। इसके लिए हाइड्रोजन के दो हैवी आइसोटोप–ड्यूटेरियम और ट्रिटियम को इस्तेमाल करते हैं। ड्यूटेरियम 'भारी पानी' से निकाला जाता है। ट्रिटियम धरती की कोख में मौजूद लीथियम से बनाते हैं। तापनाभिकीय संलयन लगभग एक करोड़ कैल्विन तापमान पर होता है। यह प्रक्रिया जिस पात्र में की जाती है, उसकी दीवारों को चुंबकीय क्षेत्र बनाकर दूर रखा जाता है, नहीं तो दीवारें पिघलकर गैस बन जायें। ड्यूटेरियम में एक न्यूट्रोन होता है और ट्रीटियम में दो। इनके संलयन से एक हीलियम नाभिक बनेगा। इसमें दो प्रोटोन और एक न्यूट्रोन होता है। इस तरह हीलियम कण डाइवर्टर पंप से बाहर करके ऊर्जा–संयंत्र में पहुंचाए जाते हैं। न्यूट्रोन आवेश रहित होते हैं, इसलिए चुंबकीय क्षेत्र से बाहर आ जाते हैं। इनमें निहित ऊर्जा से संलयन–प्रक्रिया बराबर चलती रहती है। इससे प्लाज्मा अपने आप गर्म होने लगता है। अगले छह महीने या सालभर में भारत का दूसरा टोकामैक संयंत्र चालू हो जाएगा। इसमें प्लाज्मा गोलाकार पात्र में गर्म किया जाता है। ईटर 2016 में बनकर तैयार होगा। उससे बिजली बनने में 20–25 साल लग सकते हैं। भारत 'ईटर' में अगले दशक में 2500 करोड़ रुपये के लगभग निवेश करेगा। इस समय भारत में 15 नाभिकीय रिएक्टर हैं, जिनकी कुल विद्युत–उत्पादन क्षमता 3260 मैगावाट है। परमाणु ऊर्जा विभाग ने 2020 के अंत तक 20,000 मैगावाट परमाणु–ऊर्जा से पैदा करने का लक्ष्य रखा है। यह ऊर्जा संलयन के विपरीत नाभिकीय विखण्डन से मिलती है। संलयन में रेडियोएक्टिविटी कम और थोड़ी अवधि के लिए पैदा होती है और मेल्टडाउन या विस्फोट की संभावना नहीं होती।सबसे बड़ी क्रांति तब होगी, जब नाभिकीय संलयन सामान्य तापमान पर किया जा सकेगा जिसे 'कोल्ड फ्यूजन' कहते हैं। इसका दावा 23 मार्च 1989 को मार्टिन फ्रिशमैन और स्टेनली पांस ने किया था, जो साबित नहीं हो पाया। अगले 25 वर्षों में विश्व में ऊर्जा की मांग 50 प्रतिशत बढ़ेगी और कार्बन–उत्सर्जन में भी 52 प्रतिशत बढ़ोतरी होगी, हालांकि इसमें परमाणु–ऊर्जा नहीं फॉसिल ईंधनों का दो ा होगा। अगले 50 सालों में तेल के भंडार समाप्त हो सकते हैं। अभी भारत में कुल बिजली का 2.7 प्रतिशत ही परमाणु–ऊर्जा से मिलता है, जबकि अक्षय–ऊर्जा से 5.6 प्रतिशत के लगभग बिजली पैदा होती है। फिर क्यों न

भारत सहित सभी देश अक्षय–ऊर्जा के विकास पर अधिक ध्यान दें, जो प्रदू ाण रहित है और कुल मिलाकर सस्ती पड़ती है।

मंत्री जी बना रहे हैं बायोडीजल

छत्तीसगढ़ राज्य के आदिवासी मंत्री ननकी राम कंवर महुए से बायोडीजल बनाकर गाड़ी चलाकर दिखा रहे हैं। महुए से शराब बनाने में छत्तीसगढ़ के आदिवासी माहिर हैं और वे शराब को बायोडीजल के रूप में बेचकर अच्छी कमाई कर सकते हैं। उन्होंने तीन हांडियों के नीचे आग सुलगाई और सबसे नीचे की हांडी में शराब बन गई, जिसे जलाने पर फौरन जल गई जो कि अच्छी शराब की पहचान है। ढाई सौ रुपए के महुए के फूलों से 15 लिटर शराब बन जाती है। मंत्री जी ने शराब को पेट्रोल में किस अनुपात में मिलाया जाए इस पर प्रयोग भी किए। कभी आधा पेट्रोल और आधी शराब। कभी 25 प्रतिशत पेट्रोल और 75 प्रतिशत शराब। इसी अनुपात से गाड़ी अच्छी चली। मोटर मिकेनिकों ने बताया कि कार्बुरेटर में सुधार के साथ महुए की शराब को भी रिफाइन करना पड़ेगा। महुए से बने ईथेनोल को प्रयोगशाला ने भी बायोडीजल बनाने के लिए उपयुक्त पाया है।

जैवईंधन पर जोर

दुनिया धीरे–धीरे ही सही बायोफ्यूअल यानी जैव–ईंधन की ओर खिंच रही है। यूरोपी संघ के देशों ने तय किया है कि वे सन् 2010 तक ईथेनोल–जैसा जैवईंधन मोटरकारों में 5.75 प्रतिशत तक इस्तेमाल करने लगेंगे। चीन में सन् 2010 तक 10 प्रतिशत वाहनों से जैवईंधन अपनाने का निश्चय किया है। चीन इसके लिए विश्व का सबसे बड़ा संयंत्र बना रहा है। अमरीका तो पहले ही 100 लाख टन ईथेनोल हर साल पैदा कर रहा है। अमरीका इसमें 30 प्रतिशत क्षमता की वृद्धि करने वाला है। फोर्ड कंपनी अपनी मोटरकारों में जैवईंधन के लिए जरूरी सुधार कर रहा है। ब्राजील 50 प्रतिशत ईथेनोल वाहनों में डाल रहा है। इसके लिए वह गन्ने की फसल इस्तेमाल कर रहा है। एक टन गन्ना 100 कि.ग्रा. चीनी पैदा करता है और 50 कि.ग्रा. ईथेनोल। चीनी की कीमत 1000 रुपये आंके तो ईथेनोल 900 रुपये का बैठेगा। लेकिन पूरे एक टन गन्ने से ईथेनोल ही बनाया जाए तो 500 किलोग्राम ईथेनोल बनेगा जिसकी कीमत होगी 9000 रुपये। लेकिन गन्ने की फसल पानी चाहती है। इसलिए मीठी ज्वार, जौ और मक्का के दानों और तनों के रस से जैवईंधन बनाना अधिक उपयोगी होगा। इस तरह की एक टन फसल से 380 लिटर ईथेनोल बना सकते हैं, जिसकी कीमत बैठी 6880 रुपये। इससे बारानी क्षेत्रों के किसान दुगनी कमाई कर सकेगी। अगर एक साल में हम देश में 80 लाख टन पेट्रोल इस्तेमाल करते हैं, तो 5 प्रतिशत ईथेनोल मिलाने के लिए हमें चार लाख टन ईथेनोल की जरूरत पड़ेगी। यह आठ लाख टन गन्ने से पैदा किया जा सकता है, जो कुल गन्ना–उत्पादन का मात्र 0.3 प्रतिशत होगा। इसे हम 5 प्रतिशत ज्वार और मक्का से भी पैदा कर सकते हैं जो कि 210 लाख टन के करीब प्रतिवर्ष पैदा करते हैं। मीठी ज्वार की किस्में भारतीय कृषि अनुसंधान परिषद ने विकसित की हैं जो बारानी क्षेत्रों में उगाकर केवल ईथेनोल के उत्पादन के लिए इस्तेमाल की जा सकती है। वैसे गन्ने की प्रति हैक्टर उपज महाराष्ट्र में किसानों ने 355 टन प्रति हैक्टर तक ली है, जबकि राष्ट्रीय औसत 60–70 टन प्रति हैक्टर है। डिस्टिलरी औद्योगिक यानी मिथाइल अलकोहल लोअर ग्रेड का बनाकर 6 से 10 रुपये प्रति लिटर बेच सकती है। इसे 50 प्रतिशत या अधिक केरोसिन के साथ मिलाकर ग्रामीण भारत की सारी ऊर्जा–आवश्यकता की पूर्ति की जा सकती है। सरकार एक्साइज ड्यूटी और सेल्स टैक्स माफ कर दे तो ईथेनोल और इंडस्ट्रियल अलकोहल की कीमतें काफी कम की जा सकती हैं। तेल कंपनियां इन्हें डिस्टिलिरियों से खरीद लें और बायोडीजल बनाकर बेचें। हमें इस बारे में ब्राजील से सीख लेनी चाहिए जहां चीनी मिलों के स्पैण्ट वाश से ईथेनोल बनाया गया है और अमरीका तथा यूरोपी संघ से आधे दामों पर ईथेनोल बनाता है। सन् 2005 में ब्राजील ने 14 अरब लिटर ईथेनोल बनाया।

अमरीका मुख्य रूप से ईथेनोल बनाता है और यह विश्व का दूसरा सबसे बड़ा ईथेनोल–उत्पादक है। इसकी क्षमता प्रतिवर्ष 15 अरब लिटर ईथेनोल पैदा करने की है, जो एनर्जी पॉलिसी एक्ट–2005 के अनुसार 2012 तक बढ़ाकर 28 अरब लिटर कर दी जाएगी। ईथेनोल में ऑक्सीजन होता है और इंजन ईंधन को पूरी तरह जला देता है और उत्सर्जन बहुत कम होता है और कार्बन का उत्सर्जन 80 से 95 प्रतिशत तक कम हो जाता है।

बायोडीजल के लिए रतनजोत और पोंगामिया (करंज) आदि पौधों की फसल उगाने पर ध्यान दिया जा रहा है। 20 प्रतिशत तक बायोडीजल इस्तेमाल करने पर इंजनों में कोई परिवर्तन नहीं करना पड़ेगा। 'द एनर्जी रिसर्च इन्स्टीट्यूट' टेरी के अध्यक्ष डॉ. आर.के. पचौरी का कहना है कि प्रारंभ में बायोडीजल बनाने पर 23 रुपए प्रति लिटर खर्चा आएगा जो 15 से 18 रुपये प्रति लिटर तक घटाया जा सकेगा। ब्रिटेन की 'डी–1' नामक फर्म ने हरयाणा की एक ग्राम पंचायत से समझौता किया है, जो 1000 हैक्टर में रतनजोत उगायेगी। भारतीय तेल निगम 'डी–1' से 25 रुपये प्रति लिटर में बायोडीजल खरीदकर डीजल में मिलायेगा और बेचेगा।

भारत सरकार इस वर्ष 2006 में 'राष्ट्रीय बायोडीजल अभियान शुरू करने वाली है। इसके अंतर्गत 26 लाख टन बायोडीजल उत्पादन करने का लक्ष्य है। इसके लिए जट्रोफा यानी रतनजोत के साथ ही करंज को उगाने पर अधिक बल देना होगा। क्योंकि राष्ट्रीय तिलहन एवं वनस्पति तेल विकास बोर्ड के निदेशक आर.एस. कुरील के अनुसार रतनजोत उसी मिट्टी में उग सकताहै, जिसकी ऊपरी सतह डेढ़–दो फुट गहरी हो और जहां वर्षा 600 मिलीमीटर से अधिक होती है। देश के 160 जिलों में इससे कम वर्षा होती है। रतनजोत की किस्में भी ऐसी होनी चाहिए जो हर पौधे से कम से कम 2 किलो बीज दें और बीजों में 30 प्रतिशत तेल हो। ऐसी किस्में विकसित करनी होंगी। रायपुर के कृषि विश्वविद्यालय के रतनजोत के जर्म प्लाज्म से कुछ अच्छी किस्मों की चोरी ही हो गई। 5 प्रतिशत बायोडीजल मिलाने के लिए भी देश में सन् 2012 तक एक करोड़ हैक्टर में रतनजोत उगाना होगा। इसके लिए ग्राम पंचायतों की भागीदारी जरूरी होगी।

2020 तक 16 लाख वाहन दौड़ेंगे हाइड्रोजन से

तत्कालीन पेट्रोलियम मंत्री मणिशंकर अय्यर ने फरीदाबाद में देश के पहले हाइड्रोजन सीएनजी स्टेशन का उद्घाटन करते हुए कहा कि यहां अभी सीएनजी में 5 प्रतिशत हाइड्रोजन मिश्रित की जाएगी। अभी हाइड्रोजन गैस को ईंधन के लिए इस्तेमाल करने पर और अधिक अनुसंधान आवश्यक है, ताकि इसकी कीमत कम हो जाए। हाइड्रोजन के उपयोग के बारे में बनाई गई स्टीयरिंग कमेटी के अध्यक्ष रतन टाटा ने बताया कि सन् 2020 तक भारत की सड़कों पर दस लाख वाहन हाइड्रोजन गैस से चलेंगे। हाइड्रोजन गैस के इस्तेमाल से 1000 मेगावाट बिजली भी पैदा की जा सकेगी। यह कैसे किया जाएगा इसका 'रोडमैप' भी समिति ने बनाया है। 2020 तक इस लक्ष्य को पूरा करने के लिए 25000 करोड़ रुपये का पूंजी–निवेश करना होगा, ताकि जरूरी अनुसंधान और विकास पर 1000 करोड़ रुपये खर्च किए जा सकें। पहले दुपहिए और तिपहिए वाहन और फिर टैक्सी और बसें हाइड्रोजन से चलेंगीं। इसके लिए हाइड्रोजन के व्यापारिक उत्पादन, भंडारण और परिवहन तथा वितरण का पूरा ढांचा खड़ा किया जाएगा। बिजली पैदा करने के लिए इंजनों और टर्बाइनों में भी सुधार करने पड़ेंगे।

पचास हजार गांवों में होगी रोशनी

राजीव गांधी ग्रामीण विद्युतीकरण योजना के अधीन 50840 गांवों में उजाला करने का काम तेजी से चल रहा है। 1941 गांवों में रोशनी का इंतजाम किया जा चुका है। 191 जिलों के गांवों में बिजली पहुंचाने के लिए 187 परियोजनाएं स्वीकृत की जा चुकी हैं। दसवीं पंचवर्षीय योजना के अंत तक लगभग 50,000 गांवों में रोशनी पहुंचाने का लक्ष्य है। इसके लिए 187 परियोजनाएं उत्तर प्रदेश, पश्चिम बंगाल, राजस्थान, बिहार, केरल, हरियाणा, जम्मू–कश्मीर, कर्नाटक, असम, हिमाचल प्रदेश, महाराष्ट्र, पंजाब, अरुणाचल प्रदेश, छत्तीसगढ़, नागालैंड, मिजोरम, उड़ीसा और मणिपुर राज्यों में शुरू की गई हैं।

गरीबी की रेखा के नीचे जिंदगी गुजारने वाले परिवारों के लिए बिजली के कनेक्शनों पर 100 प्रतिशत सब्सिडी दी जाएगी। पूरी परियोजना के खर्च की 90 प्रतिशत धनराशि सब्सिडी के रूप में दी जाएगी, जब कि शेष 10 प्रतिशत लागत के लिए आसान शर्तों पर ऋण दिया जाएगा। इस ऋण पर ग्रामीणों को केवल 5 प्रतिशत ब्याज देनी होगी।इस योजना से जहां इन गांवों में घरों का अंधेरा दूर होगा, वहीं जीवन–स्तर भी सुधरेगा। बिजली से खेतों की सिंचाई के लिए पम्पसैट भी चलाए जा सकेंगे। लघु और मध्यम स्तर के उद्योग, खादी और ग्रामोद्योग चलाने तथा स्वास्थ्य, शिक्षा, सूचना–प्रौद्योगिकी की सुविधाएं विकसित करने के लिए इन गांवों में आवश्यक ऊर्जा उपलब्ध कराई जाएगी।

यूरेडा फैला रहा है उत्तरांचल में अक्षय ऊर्जा का प्रकाश

उत्तरांचल रिन्यूएबल एनर्जी डेवलपमेंट एजेंसी (यूरेडा) ने गांवों में बिजली पहुंचाने के लिए अक्षय ऊर्जा के साधनों का बड़े स्तर पर उपयोग करना शुरू किया है। इसके लिए यूरेडा का पनबिजली कार्यक्रम उन दूरस्थ गांवों में चलाया जा रहा है, जहां पानी के सदाबहार स्रोत उपलब्ध हैं। 20 किलोवाट से 500 किलोवाट की 32 परियोजनाएं अब तक पनबिजली पैदा करने के लिए शुरू की जा चुकी हैं। इनमें बिजली बनाना चालू है। 8 अन्य प्रायोजनाओं का निर्माण कार्य चल रहा है और 9 प्रायोजनाओं को सामुदायिक भागीदारी से चलाने के लिए काम शुरू हो गया है। परंपरागत पन–चक्कियों (धराटों) को फिर से चलाने और सुधारने के लिए केन्द्रीय अपारंपरिक ऊर्जा–स्रोत मंत्रालय की सहायता से कार्य सम्पन्न हो रहा है।बच्चों में सौर–ऊर्जा के प्रति जागरूकता पैदा करने के लिए सरकारी स्कूलों में सौर–शिक्षा–किट बांटे गए हैं। गांवों में और खेतों में जंगली जानवर जान–माल का नुकसान न कर पाएं इसके लिए सोलर–फेंसिंग (सौर–बाड़ाबंदी) का काम शुरू किया गया है। अभी तक 490 किलोमीटर सौर–बाड़े बना दिए गए हैं। सौर–ऊर्जा से घरों में रोशनी करने के लिए सौर–लालटेनों को सब्सिडी देकर उपलब्ध कराया जा रहा है। राज्य स्तरीय ऊर्जा पार्क बनाने, बैटरी–चालित वाहनों और जैव–ऊर्जा के कार्यक्रमों पर भी यूरेडा बहुत बल दे रहा है।

एशिया का सबसे बड़ा सोलर बिजलीघर राष्ट्रपति भवन में बनेगा

भारत के दूरदर्शी वैज्ञानिक और राष्ट्रपति महामहिम डॉ. ए.पी.जे. अब्दुल कलाम ने हैदराबाद में आयोजित भारतीय विज्ञान कांग्रेस के 93वें अधिवेशन में घोषणा की कि राष्ट्रपति भवन में एशिया का सबसे बड़ा सोलर बिजलीघर बनाया जाएगा। वे यहां पर आयोजित 'ग्रीन बिल्डिंग कांग्रेस' मं बोल रहे थे। सौर–ऊर्जा पर आधारित यह बिजली घर आठ मेगावाट बिजली पैदा करेगा। इस बिजलीघर को राष्ट्रीय ग्रिड से जोड़ा जाएगा, ताकि राष्ट्रपति भवन में उपयोग के बाद बची फालतू बिजली दूसरे कामों में खपाई जा सके। राष्ट्रपति जी ने कहा कि ऐसे बिजलीघरों से बिजली तो मिलेगी ही, साथ ही कार्बन डाइऑक्साइड, सल्फर डाइऑक्साइड और नाइट्रोजन ऑक्साइड जैसी गैसों से मुक्ति मिलेगी। डॉ. कलाम ने वैज्ञानिकों को सुझाव दिया कि वे सोलर सैलों की दक्षता 15 प्रतिशत से बढ़ाकर 45 प्रतिशत करने के लिए सिलीकन वोल्टेइक सैल के साथ ही सीएनटी (कार्बन नैनो ट्यूब) के उपयोग पर अनुसंधान करें। उन्होंने कहा कि निर्माण–उद्योग ऊर्जा की भारी खपत करता है। अगले 15 सालों में देश में 15 करोड़ मकान बनाए जाने हैं। राष्ट्रपति जी ने सुझाव दिया कि भवन–निर्माण में 15 प्रतिशत ऊर्जा और 10 प्रतिशत पानी की बचत करनी चाहिए। उन्होंने भारतीय उद्योग परिसंघ (सीआइआइ) को सुझाव दिया कि भवन–निर्माण की हरी प्रौद्योगिकी के बारे में आर्कीटैक्ट और योजनाकारों को प्रशिक्षित किया जाना चाहिए। उन्होंने इस अवसर पर आर्कीटैक्चर के तीन विद्यार्थियों को पुरस्कृत किया, जिन्होंने ग्रीन बिल्डिंग के बारे में अपनी सूझबूझ पर आधारित प्रेरणाप्रद शोध पत्र प्रस्तुत किए थे।

66 हजार बायोगैस संयंत्र लगेंगे

लोकसभा में जानकारी देते हुए केन्द्रीय अपारंपरिक ऊर्जा–स्रोत राज्य मंत्री (स्वतंत्र प्रभार) श्री विलास मुत्तेमवार ने बताया कि सरकार ने ग्रामीण क्षेत्रों में बायोगैस संयंत्र लगाने के लिए अनेक कदम उठाए हैं। इसके लिए ग्रामीण महिलाओं को प्रशिक्षित किया गया है, ताकि एक बार लगा देने के बाद बायोगैस संयंत्रों की सही देखभाल और मरम्मत का काम महिलाएं खुद करती रहें और बायोगैस संयंत्र बराबर चलते रहें। इन संयंत्रों के लिए तीन साल की वारंटी भी दी जा रही है। सन् 2005–06 में देश के देहाती इलाकों में 66,000 बायोगैस संयंत्र लगाए जाएंगे। पहले यह संख्या 25,000 तय की गई थी। लेकिन संशोधित बजट अनुमानों ने इसके लिए निर्धारित धनराशि 14 करोड़ रुपये से दुगनी, 28 करोड़ रुपये कर देने के बाद बायोगैस संयंत्रों की संख्या बढ़ाकर 66 हजार कर दी गई। अक्षय ऊर्जा प्रणालियों को बढ़ावा देने के लिए अपारंपरिक ऊर्जा–स्रोत मंत्रालय ने राज्यों और संघ शासित प्रदेशों के सभी इंजीनियरिंग कालेजों और तकनीकों संस्थानों में अक्षय ऊर्जा क्लब स्थापित करने का निर्णय लिया है। इसके लिए मंत्रालय ने पूरे देश में अपनी नोडल एजेंसियों को परिपत्र भेजा है और प्रस्ताव मांगे हैं। फिलहाल पूरे देश में 1300 अक्षय ऊर्जा क्लब खोलने की योजना है।

WORKSHOP ON PROMOTION OF COGEN/CAPTIVE POWER PLANTS IN DISTILLERIES AT MUMBAI

A one-day workshop on Promotion of Cogen/ Captive Power Plants in Distilleries in the Western and Central Region was held at Mumbai on 13 January 2006. The workshop was organised by Cogeneration Association of India, Pune and was sponsored by MNES. 76 delegates participated in the workshop. The delegates included consultants, equipment suppliers and sugar mill owners/ managers. The workshop was inaugurated by Shri V.N. Raina, Secretary General, All India Distilleries Association.

Shri R.C. Tiwari, Director, MNES delivered the keynote address, wherein he highlighted the latest schemes of the ministry for financial assistance for promotion and development of these projects. Shri Vinay Kore, Minister for Non-conventional Energy Soruces & Horticulture, Government of Maharashtra while delivering the inaugural address emphasized the need to develop decentralized cogen and captive power plants. There was need to augment investments in R&D in this sector, he said.

In the policy session of the workshop a presentation was made by Shri S.C. Natu, Secretary, Cogen India on "Need & Potential for Cogen/Captive Power Plants at Distilleries". Shri R.C. Tiwari, Director MNES presented the details of MNES schemes for promotion of cogen/captive power plants based on industrial and commercial waste and bagasse.

In the session on financing options for cogen/ captive power projects Shri S. Baskaran, Asstt. General Manager, IREDA explained the various options that are available from IREDA to prospective cogenerators and also how IREDA is making efforts at promoting easy finance availability.

In the technical session on technology various presentations were made on the options in implementing cogen/captive power projects at distilleries. Some of the papers also spoke of the need to improve energy efficiency in distilleries. Two

Shri Vinay Kore, Minister for Non-conventional Energy Sources, Govt. of Maharashtra during the Regional Workshop at Mumbai

presentations were made on multifuel fired boilers and another on biogas fired engines.

Two case studies were presented to show actual implementation and successful running of cogen projects. They were the Kanoria Chemicals Ltd., Ankleshwar and Brihan Maharashtra Sugar Syndicate, Sholapur.

Among the recommendations made included a system integrated approach with tailor made solutions for each unit. It also called for networking at regional, state and central levels with awareness campaigns. The need for conducting energy audits and implement the changes soon was emphasised. Technological options such as rankine cycle and gas engines require assessment of their techno-economic evaluation, demonstration projects for both technologies for different capacity ranges of distillery units. It also calls for dissemination of information and sharing of results. ❑

बिजली की खपत में बचत करने के लिए अक्षय ऊर्जा उत्पाद प्रयोग में लाएं।

REGIONAL BUSINESS MEET ON WIND ENERGY

A Regional Business Meet on Wind Power Energy and its Prospects was held on 3 February 2006 at Kolkata. The workshop was organised by Dimentiosn Engg. Consultants Pvt. Ltd., New Delhi and was sponsored by IREDA, New Delhi.

The workshop was inaugurated by Shri P. Ray, Member (Technical) West Bengal Electricity Regulatory Commission. In his address to the workshop he spoke of the concerns of the regulator in deciding tariff especially for power from renewables. He also spoke of the draft regulation on cogen and other renewables.

There were two technical sessions in the workshop. In the first technical session Shri K.B. Shingwekar, Technical Officer, IREDA made a presentation on the financing schemes of IREDA with special reference to the schemes for wind sector. In addition he also spoke of the need to invest in renewables and close the demand gap. He spoke of the investment options available and the fiscal and financial incentives available for the sector. Several case studies were shown to prove the points he made.

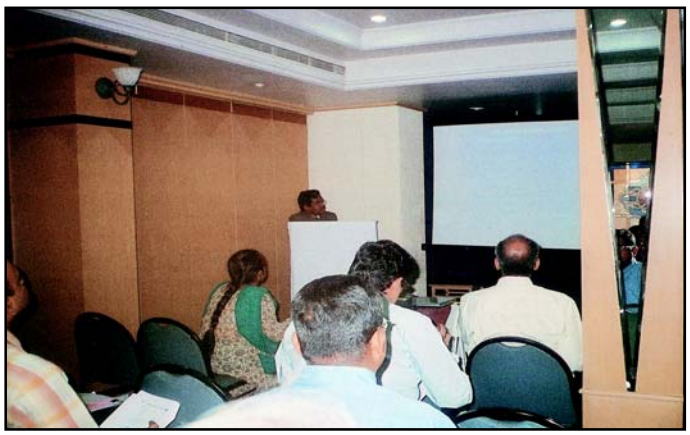
Prof. Sujay Basu spoke of the large investment area in wind sector especially in States with large wind power potential. The wind sector, he said, is the fastest grwoing power sector in the country and the world. He called for intensive R&D to keep costs in keeping the costs of the machines lower and also make them more reliable. There is need to develop technical strength to make the sector internationally competitive. ❑

MEETING ON ENERGY EFFICIENCY & CONSERVATION

A business meet on Energy Efficiency and Conservation was held at Mumbai on 14 January 2006. The meet was organised by MITCON Consultancy Services Ltd., Pune & Reliance Energy Ltd. and was sponsored by IREDA. The purpose of the meet was to highlight the need to incorporate energy efficiency and conservation in Indian industry. 29 delegates attended the meet from different end user companies. In the first technical session Shri Deepak Zade, from MITCON highlighted the need of energy conservation, potential and achienvements.

Shri S. Baskaran, AGM, IREDA made his presentation giving an overview of the various financial schemes of IREDA and its role in promotion of energy efficiency and conservation.

In the second technical session, papers were presented on harmonic suppression and power factor improvement, building automation systems and performance contracting, energy efficient electrical motors, lighting systems and role of CDM in promotiuon of EEC. Case studies were presented on each of the topics covered and there was an interactive session wherein doubts were clarified by the speakers. Several speakers spoke of the need to share experiences and positive outcomes. ❑



Shri S. Baskaran, AGM, IREDA making his presentation at the technical session at the Business Meet at Mumbai

BUSINESS MEET ON SMALL HYDRO ENERGY

A Business Meet on Small Hydro Energy was organised at Jammu on 20 January 2006. The meeting was organised by J&K Industrial and Technical Consultancy Organisation Ltd. and was sponsored by IREDA, New Delhi.

The Bussiness Meet was attended to by 34 delegates. The meet was inaugurated by Sh Nawang Rigzin Zora, Minister for Power, Industries & Commerce, J&K government. In his inaugural address he appreciated the role of J&KITCO in the industrial development of the State and the need to set up small hydropower projects to cater to the needs of industry.

Shri Muzaffar Butt, MD, J&K State Power Development Corporation spoke of the hydro power potential in the state and stressed that small hydro projects have to play an important role towards sustainable energy. He also informed that 37 schemes have been open for private sector developers.

Shri S.K. Dey of IREDA in his presentation told that small hydro stands in the first place in generation of electricity and has been estimated with a potential of 15,000 MW. He also informed about the role of

Shri S. K.Dey, IREDA (seated extreme right) at the technical session at the Business Meet on Small Hydro Energy at Jammu

IREDA in promoting, developing and financing new and renewable sources of energy. He apprised about the different schemes for small hydropower development.

There was an interactive session on the policy guidelines, fiscal and financial incentives, concessions available and the technical expertise available for the growth of the sector. Experts from different sectors of the hydropower development presented case studies on projects that have become operational for the benefit of delegates. ❑

BUSINESS MEET ON WIND ENERGY INVESTMENTS IN MAHARASHTRA

A Business Meet on Wind Energy Investments in Maharashtra was held at Mumbai on 14 December 2005. The meet was jointly organised by Malaviya Energy Consultancy and Indian Merchants' Chamber and was sponsored by IREDA, New Delhi. 34 participants attended the meet, including previous investors besides some of the new investors. The participants were corporates and members of the Chamber of Commerce.

Considering the immense potential that Maharashtra possesses favourable policies will atract investments from industries with attractive tariffs. The meet was inaugurated by Dr. Pramod Deo, Chairman, MERC.

In his inaugural speech mentioned that wind turbines yield more than 16 % return on equity, in addition to incentives in sales tax, income tax and customs duty. Moreover power generated by the wind turbines earn an attractive price from state level grids. He mentioned that MERC needed to adopt yardstick namely 'cost plus return' for determinig the price of renewable energies.

In his address to the meet, Shri Abhilakh Singh, AGM, IREDA spoke of the revised financing norms of IREDA. He mentioned that IREDA has sanctioned about Rs.2,400 crore for wind projects. The reduced rate of interest did certainly appeal to the investors.

Shri S.R. Chaudhary highlighted the present development of wind energy in Maharashtra and brought out the role of MEDA. He also said MEDA is undertaking to ensure that forest land is made available for development of wind farms as per the policy laid by the forst department.

Shri Inder Bhamra of NEG-MICON, Shri Sandeep Dasgupta of Suzlon and Shri V. Ramachandran of Vestas RRB made presentations about their achievements in Maharashtra and in the country. The participants requested IREDA and Government to simplify procedures for investments in wind sector. ❑

Shri Abhilakh Singh, AGM, IREDA addressing the Business Meet on Wind Energy Investments in Maharashtra at Mumbai

EASTERN INDIA RENEWABLE ENERGY SUMMIT 2006

The Eastern India Renewable Energy Summit 2006 was held at Kolkata on 10 March 2006. The theme of the summit was "Doubling the Capacity by 2010 – The Road Map and New Issues." The Summit was organised by India Energy Forum and The Bengal Chamber of Commerce and Industry. The Summit was sponsored by MNES, IREDA, NTPC, SREI, among others.

The summit was organised to address the issue of detailing the roadmap for the doubling of capacity by 2010 and to work out strategies for growth, augmenting viable sources, removing obstacles, revamping policy framework, creating the market, rationalising incentives, etc.

The Summit was inaugurated by Shri V. Subramanian, Secretary, MNES. In his inaugural address, Shri Subramanian said that MNES has already put up a Renewable Energy Policy document which is being circulated for comments from the various stakeholders. In the meanwhile the ministry has been proactive with suitable schemes and incentives for the organised growth of all renewable energy sectors. He also felt that investors to this sector have been carefully confident that the policy framework will enable doubling of capacity with organised growth and competition.

Shri Debashish Majumdar, MD, IREDA chaired an experts round table on strategies for growth. ❑

Shri V. Subramanian, Secretary, MNES addressing the Eastern India Renewable Energy Summit 2006 at Kolkata

BUSINESS MEET ON SMALL HYDRO ELECTRIC PROJECTS AND WIND POWER GENERATION

A business meet on Small Hydroelectric Projects and Wind Power Generation was sponsored by Indian Renewable Energy Development Agency (IREDA) and organized by Orissa Renewable Energy Development Agency (OREDA) and Project Development Consultants (PDC) on 10 January 2006 at Bhubaneshwar.

In his keynote address Shri K.C.Mohapatra, Ex.Chairman O.S.E.B/Chairman P.D.C expressed his gratitude to the delegates for participating in the Business Meet. He said that in order to reach a GDP of 7 - 8%, the requirement of power will be in the order of 12%. With the difficulties of rehabilitation of and depletion of forest, there will be difficulties in implementation of large hydropower projects. Therefore, there is no alternative than to lay emphasis on development of renewable energy projects.

He also said the potential of hydro and wind energy in Orissa is about 2,000 MW. Orissa Electricity Regulatory Commission has given suitable tariff for these projects based on the acceptable capital cost of such projects by the State Technical Committee (STC) and ensuring 14% return on the equity. He also said that GRIDCO have been advised for connectivity to 11 KV / 33 KV and 132 KV. OERC has also decided for special consideration of such projects so that atleast 5% of the energy required by the State can be produced from these sources by 2012. He spoke of the difficulties experienced by the private developers.

Shri R.P. Mohapatra, Ex-Member, OSEB in his presentation explained the encouragement extended by OERC for accommodating the suitable tariff for such projects ensuring 14% return on equity contribution. This would mean that there is no specific ceiling as fixed by some other States for the development of Renewable Energy. But the capital cost of the projects should be accepted by the STC. This is available for specific quantum of energy for each year so that 5% of energy is available from the renewable sources by the year 2012.

Shri H.S. Rauth, D.G.M. IREDA, New Delhi in his presentation explained the major role played by IREDA in development of small hydropower in the country. He informed that the country has potential of developing 10,281 MW of power from hydropower sources. He explained the fiscal incentives are offered by IREDA & MNES for development of small hydropower upto 25 MW station capacity. Some States have availed of substantial incentives for development of such projects. IREDA has circulated the policy of the IREDA and MNES to the developers. He urged upon the Government to address the difficulties raised by the developers specially with reference to variable tariff structure/wheeling charges as fixed by CERC or wheeling power outside the State/exemption of water cess, as has been offered by other State Government.

Shri D. Vaidyanathan, Senior Vice President, ITCOT, Chennai explained the potential available for wind power projects in the State. He also informed that certain studies have been done for development of 80 MW of power from Wind Mill in Sunabeda in Orissa.

Shri A.K. Nenawati, President, M/s Jayashree Chemicals Ltd., who are developing two SHPs. (24.8 MW) required certain clarifications regarding availing of Carbon credit and specific incentive for obtaining subsidy for their projects coming up in the hilly areas of the State.

The delegates to the business meet were informed that the Government of Orissa have already notified the criterion of hilly area and they may approach MNES suitably for consideration of incentives for hilly area. ❑

NATIONAL STAKEHOLDER CONSULTATION:GENDER ISSUES, MDG AND POVERTY ALLEVIATION FOR CSD 14

A "National Stakeholder Consultation: Gender Issues, MDG and Poverty Alleviation for CSD 14" was organised at New Delhi on 16 March 2006. The consultation was organised by IRADe and AIWC, New Delhi and was sponsored by ENERGIA, International Network on Gender and Energy, Netherlands.

Dr. Jyoti Parikh, ED, IRADe said that at least 80-90 percent of women in rural and semi-urban areas still toil for fuelwood taking the responsibility of meeting their daily requirements. Mr. Rakesh Bakshi, MD, Vestas RRB India said that if infrastructure can be provided for giving energy at the grassroots level though a conclusive programme of renewable energy like small hydropower, wind and biomass power some issues of MDG would be addressed.

Dr. Girija Vyas, Chairperson, National Commission for Women said that women are paid low wages for similar work in rural areas and that a small beginning has been made by starting gender budgeting in all ministries.

In his keynote address Dr. Prodpto Ghosh said that CSD is all about sustainable development, energy, environment and equity. He mentioned that many policy makers are ignorant of MDG and climate change and it is only in the 1960s that the environment movement came to the fore. Global climate change has brough major challenges since it determines the pattern of human distribution, development, use of fossil fuels, etc. He stressed that electricity is not the only energy required but also biomass based energy because of its potential. Dr. Kirit Parikh concluded by stating that 35% of subsidised energy does not reach the poor.

In the Panel Discussion on Energy, MDG, Poverty Alleviation and Gender Issues in CSD 14 which was chaired by Shri V. Subramanian, Secretary MNES,

Shri V. Subramanian, Secretary, MNES chaired a Panel Discussion at the National Stakeholder Consultationon Gender Issues, MDG, and Poverty Alleviation for CSD 14 at New Delhi

Dr. Kinsuk Mitra, President, Winrock International India said that it was important to connect technology to the poor people since users are far removed from technology. Energy demand and function, he said, need clarity. Mr. D. Majumdar, MD, IREDA on the other hand gave more emphasis on empowering women by making them enterpreneurs. Women can be made a part of a supply chain of energy by creating a better understanding. Women, he said, are more efficient users of energy and energy products. Dr. P. Dhamija, Scientist - F, MNES said that women have felt that interventions have certainly changed their lives. Shri Subramanian concluded with the recommendations which emphasised on basic issues like better fuels for cooking, eduction and health. He felt that it is important to understand the difference between electrification and energy. Shri Subramanian felt that wind power cannot be a captive tool for rural energy because of its capital intensive nature, and called for flexible regulations as far as rural energy is concerned.

Dr. Sneh Lata Kumar, highlighted the role of public participation and bringing technology to the grassroots level and the advantage of easy access to micro credit and the importance of a facilitator. ❑

WORKSHOP ON PROMOTION OF COGEN/CAPTIVE POWER PLANTS AT DISTILLERIES AT BANGALORE

A one-day workshop on Promotion of Cogen/ Captive Power Plants at Distilleries in the Southern Region was held at Bangalore on 9 December 2005. The workshop was organised by Cogeneration Association of India, Pune and was sponsored by MNES. 68 delegates participated in the workshop. The delegates included distillers, consultants, equipment suppliers and sugar mill owners/managers. The workshop was inaugurated by Shri V.N. Raina, Secretary General, All India Distilleries Association.

Shri R.C. Tiwari, Director, MNES delivered the keynote address, wherein he highlighted the latest schemes of the ministry for financial assistance for promotion and development of these projects. Dr. B.S. Shivalingiah, MD, Karnataka Renewable Energy Development Agency Ltd. graced the event emphasized the need to develop decentralized cogen.

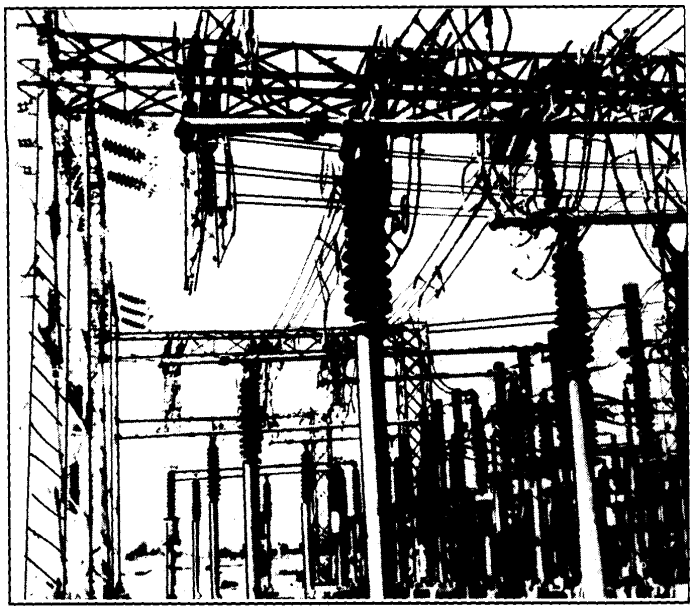
In the policy session of the workshop a presentation was made by Shri Sandeep Junjarwad, Business Manager, Cogen India on "Need & Potential for Cogen/Captive Power Plants at Distilleries". Shri R.C. Tiwari, Director MNES presented the details of MNES schemes for promotion of cogen/captive power plants based on industrial and commercial waste and bagasse. Shri Kodandarama Murthy, of NEDCAP and Shri Ramesh Nagar, DGM, KREDL outlined the efforts being done by the State Nodal Agencies in this field.

In the session on financing options for cogen/ captive power projects Shri N.R. Singh, Manager, IREDA explained the various options that are available from IREDA to prospective cogenerators and also how IREDA is making efforts at promoting easy finance availability. Shri A.K. Jai, GM, Power Finance Corporation laid emphasis on the policy isues governing the setting up of cogen and captive power plants in distilleries.

In the technical session on technology various presentations were made on the options in implementing cogen/captive power projects at distilleries. Some of the papers also spoke of the need to improve energy efficiency in distilleries. Two presentations were made on multifuel fired boilers and another on biogas fired engines.

Two case studies were presented to show actula implementation and successful running of cogen projects. They were the Samsons Distillers, Davanagere and Birhan Maharashtra Sugar Syndicate, Sholapur, Maharashtra.

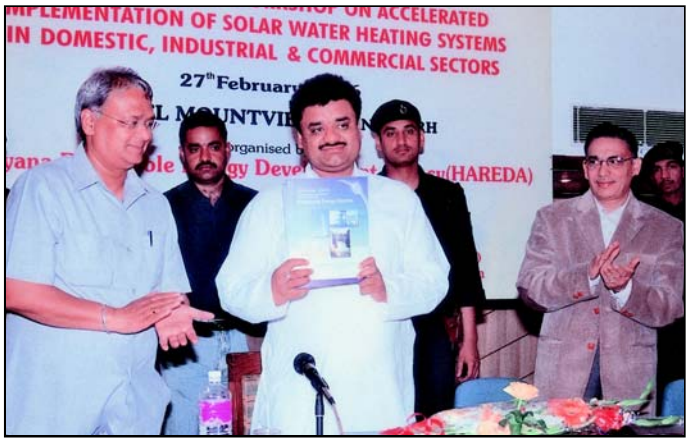
Among the recommendations made included a system integrated approach with tailor made solutions for each unit. It also called for networking at regional, state and central levels with awareness campaigns. The need for conducting energy audits and implement the changes soon. Technological options such as rankine cycle and gas engines require assessment of techno-economic evaluation, demonstration projects for both technologies for different capacity ranges of distillery units. It also calls for dissemination of information and sharing of results. ❑



WORKSHOP ON ACCELERATED IMPLEMENTATION OF SWHS IN DOMESTIC, INDUSTRIAL AND COMMERCIAL SECTORS

Haryana Renewable Energy Development Agency (HAREDA) organised a one–day Northern Region Workshop on Accelerated Implementation of Solar Water Heating Systems in Domestic, Industrial and Commercial Sectors for the States of U.P., Rajasthan, Uttaranchal, Himachal Pradesh, Haryana, Punjab and Chandigarh on 27 February 2006 at Chandigarh. The workshop was organised in collaboration with Ministry of Non-conventional Energy Sources (MNES), Indian Renewable Energy Development Agency (IREDA), Punjab Energy Development Agency (PEDA) and Department of Science & Technology (DST) UT Chandigarh.

The workshop was inaugurated by Shri Chander Mohan, Hon' ble Deputy Chief Minister Haryana. Speaking on the occasion he stressed the need for harnessing the renewable energy potential of the State and conserving the precious conventional fuels for other gainful applications. He said that the State Govt. is spending an amount of Rs.11.85 lac during the current financial year for implementation of Renewable Energy Programmes. He said that the State Govt. has fixed a target for setting up of renewable energy base power project of 500 Megawatt by the year 2012. He also talked about the State Govt. Renewable Energy Power Policy and informed that proposals have been invited from the independent power producer for setting up renewable energy based power project. He further said that there is enormous potential for solar energy utilisation in Haryana and accordingly programmes on Solar Water Heating Systems, Solar Cookers, Solar Pumps and solar home lighting systems are very popular in the state but, due to limited target and financial assistance from the Govt. of India, these programmes have not yet reached the all the people of the state. He requested MNES to sanction target and financial assistance to the States as per their demand to enable to reach the people. On this occasion he also released the document on State Govt. policy on promotion of generation of electricity through renewable energy sources.



Shri Chander Mohan, Deputy Chief Minister, Haryana releasing the Renewable Energy Power Policy document of Haryana Government on 27 February 2006

Speaking on the occasion, Shri S.C. Choudhary, IAS, Financial Commissioner & Principal Secretary, Renewable Energy Department, Government of Haryana informed that the department is implementing various renewable energy programmes in the State and has so far installed about 800 solar water heating systems of 6,50,000 LPD capacity in the State. He said that the solar water heating technology is one of the most economical and viable option for low temperature range water heating applications and keeping in view the growing energy costs and environmental concerns, it is the right time when we should switch over from conventional energy to non-conventional energy sources. He further informed that with the growing awareness and increasing energy costs, people are adopting solar water heating systems and with the Haryana Government notification on mandatory use of solar water heating systems, the scene will change in very near future in the State. He said that the State Government has made the use of solar water heating systems mandatory in the process industries, hospitals and nursing homes, banquet halls, jail barracks and canteens, housing complexes set up by Group Housing Societies, residential houses built on plot of size 500 sq. yds. and above, residential schools, tourism

complexes etc. As a result, solar water heating systems are being installed in the State in larger numbers.

Delivering the keynote address, Shri Ajit Gupta, Adviser, MNES said that a vast potential exists in the country for installation of solar water heating systems. More efforts and focused approach is required to tap this potential. He lauded the initiatives taken by the Haryana Government on mandatory use of solar water heating systems and other energy conservation measures. He said that soft loans @ 2% to 5% is available for installation of solar water heating systems and the Ministry expects a boom in the demand for solar water heating systems.

Speaking on the occasion, Smt. Sumita Misra, Director, Renewable Energy & HAREDA stated that a substantial amount of energy is used for heating the water for various applications in these establishments. With the growing cost of energy and the demand supply gap, there is a need to adopt solar water heating technology, which is abundantly available in India. Solar Water Heating Technology is 'not only replenishable but also pollution free.

Later in the technical sessions, presentations were made by Dr. Bibek Bandopadhyay, Adviser, MNES, Dr. A.K. Singhal and Dr. Ashwani Kumar, Directors from MNES, Shri C. Shantalingam from Canara Bank, Bangalore Shri A.A. Khatana, Chief General Manager, IREDA and Shri B.S. Yadav, Project Director, Renewable Energy Department, Haryana on policy, standardisation and the testing, implementation and financing aspects of the programme. Presentations were also made on installation and micro-financing of solar water heating systems.

Shri Debashish Majumdar, MD, IREDA (seated third from right) with other delegates at the technical session of the workshop organised by HAREDA at Chandigarh

The workshop made the following recommendations to accelerate the adoption of solar water heating systems in northern states,

1. Aggressive advertising and marketing strategies through electronic media should be adopted.
2. Industries may be encouraged for adoption of Solar thermal technologies through pilot projects particularly for high hot water consumption industries like textiles, pharmaceuticals and food processing etc.
3. The users of Solar Water Heating Systems may be given tax incentives in direct taxes and rebate in electricity bills.
4. To build the confidence of the industry in solar water heating technologies, Energy service company Model may be adopted in few pilot projects to convince the users, design and carry out systems engineering to meet the requirement of the industry, financing of the systems, recovery of the costs on energy delivered basis, O&M etc.
5. Evacuated Tube based systems are being imported in India mostly from China. It was recommended that the quality of the tubes maybe ensured so that the systems have a life period about Ten Years or more.
6. It was recommended that since most of the suppliers of Solar Water Heating systems are located in South India, there is a need to set up manufacturers network in the Northern India as well so that the demand of Solar Water Heating systems may be met and the prices of the systems may be competitive. The representatives of the Karnataka Solar Water Heating systems manufacturers association assured their involvement in the programmes in Northern States in future.