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Renewable Energy Options in North-Eastern India: Some Possibilities

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Abstract

Energy is a vital constituent of the process of economic development. It is considered as an essential infrastructural input requirement for economic upliftment as well as social welfare. Energy demand is growing faster because of increasing population and economic activities. In the prevailing situation renewable energy sources are economically viable which open the practical option for most of the developing economies. Especially in the difficult terrain like the North-Eastern part of India, the experiment of fulfilling energy requirements by these sources may serve well the purpose. Present paper, thus, analyses the relevance of energy sector in general and scope of renewable sources in particular in the North-Eastern part of India. The cases of wind and solar energy are discussed along with their respective advantages over the conventional energy supply system. The economic analysis indicates a vast scope for this type of energy source in North-Eastern part of India. The suitable incentives and systematic development would make renewable energy as an attractive option with long term benefits.

Key words: Energy resource, Socio-economic needs, Appropriate technology, Systematic development.

Introduction

The development of infrastructural sector is an essential pre-condition for economic growth. This sector can be divided into two: economic as well as social infrastructure sector, which include education, health, sanitation as social facilities and basic industries like transport facility, manufacturing and basic industries and energy sector as economic infrastructure. Realizing the importance of this fact, the status and relevance of renewable energy options in North -Eastern part of India, is examined in this paper. The generation and supply of conventional energy sources are also briefly discussed. The crucial issues involved in comparing non-conventional and commercial generation and marketing their respective impact on environment are described. In addition, the economics of various renewable energy sources is also, included in this paper.

Relevance of Energy Sector

Energy sector is the backbone of economic development. It is treated as one of the important input resources for industrial and other economic activities. It is for this reason, the energy sector warrants the priority for the functioning and the development of most of the economic activities in any region. This is also evident from the fact that during the last eight five -year plans the energy sector has been a single most important sector where largest amount of finances are invested, which resulted in significant development of this sector in India. Despite this, the present level of energy output is not sufficient enough to satisfy the growing demand of energy resulted because of increasing population and economic activities. The fast depletion of cheap fossil fuels, requirement of a cleaner environment and better ecology balance make the energy issue more complex today than ever before.

As an average, twenty six percent of the Indian population (about 950 million) lives in urban areas. There energy needs are fulfilled by non-commercial and commercial sources. A sizable share of the requirement of rural households is met by non-commercial sources like fuel wood, agricultural residues, animal waste and human as well as animal power. These resources are steadily getting replaced by commercial fuels.

There is a sharp increase of about 352 % in the total energy supply (commercial and non-commercial) from 82.70 MTOE (million tones of oil equivalent.) in 1950 - 51 to about 291 MTOE in 1990-91, with average annual rate of growth of 8.7%. In this connection, the share of non-commercial fuels has been declined from 74% to 41% during same period of time. Fuel wood is important non-commercial energy source which accounts for 65% of the total non-commercial energy consumed. So far as the commercial energy supplies are concerned, coal continues to be the main primary source.

The elasticity of final consumption of commercial energy with respect to Gross Domestic Product (GDP) , which measures the efficiency of it's use , is defined as the proportionate amount of energy used to marginal increase in GDP. Lower the coefficient of elasticity reflects the efficient use of energy and *vice -versa*. This coefficient of elasticity has declined from 1.37 (1979-80) to 0.82 (in 189-90). This declining trend is mainly due to changes in technologies. There have also been recorded the significant changes in the sectoral pattern in the use of commercial energy in India. It's use in industrial sector is increased nearly 17.2% from 39.8 % in 1953 to 57.0 % in 1980 and then decreased by 6.6% during the 1980's. It's use in the agricultural sector grew steadily from 1.70 % to 6.10 % and 9.00 % during 30 years

of pre-green revolution period (1950-51 to 1980-81). The use in service sector has also recorded a declining trend from 46.2 % to 23.50 % during the subsequent period of time and then marginally increasing to 24.50 % in 1990.

So far as changes in the share of renewable and non-renewable conventional energy resources are concerned, it is obvious from the concerned statistics that, despite of increasing the total consumption of these resources, the share of coal supply has been decreased steadily by 40.0% during the last 38 years from 79.6% (in 1953) to only 39.00% (in 1990). It may be due to concentration of coal areas in the country. The Chhotanagpur plateau produces more than 80% of total coal production of India. On account of cumbersome technique of coal digging and high costs of its supply to the industrial areas and thermal power generation plants, there is a record sectoral shift of energy resource supply from the coal to the oil, natural gas and hydro-electric generation of power. Thus, the share of oil and natural gas supply has rose by 26.3% from 17.1% to 43.40% and the share of electricity supply has been increased by 14.30% from 3.30 to 17.60% during the same period of time (1953 to 1990).

At present, the assessment of hydro- power potential is 600 billion units, which amounts for 84,000 Mega Watts (MW) at 60% load factor . It is significant to note that out of total hydel potential nearly 14% has been so far developed and another 7.00% is being developed through mini/micro/small hydel schemes. Another source of conventional energy is oil and natural gas in the form of geological reserves of hydrocarbons are at 21.31 billion tonnes of which 61.00% are off shore and 39.00% on land. Out of which, the established geological reserves are only 5.32 billion tonnes. It is stipulated that half of the reserves represent natural gas of which only 12% has been established. Nuclear power, as a promising source of energy, in near future could only possible with fast-breeder technology. At present potentiality of nuclear power is very limited in India.

Need and Scope of Renewable Energy Sources

Renewable sources of energy are a viable and practical option open for a developing economy like India. This option can also contribute substantially to environmental protection and could offer vast opportunity to local industries, accelerate rural development. This also develop more decentralized energy supply system. As far as the renewable sources of energy are concerned, solar energy is abundant, wind energy is estimated potential as about 20,000 MW. There is also some scope for exploiting geo-thermal, ocean thermal and tidal energy at certain location.

Extensive afforestation at village level in rural areas can meet the local biomass requirements.

Table-1 reveals that energy supply has been continuously increasing . however, this increased in supply is not sufficient to meet the ever growing demand This means to say that, the energy demand is growing with much faster rate than energy supply.

This shortage is further aggravated when the difference between peak load power supply and power demand varies between 15.00 and 20.00 %. This increasing trend in power consumption poses a serious challenge for future.

According to the estimates of future projection demands, energy requirement would be 824 billion units by 2006 - 07. The production requirements of coal and hydro-carbons would also grow accordingly, but limited reserves and exploration put major challenge for planners. This fact become more important as energy is going to play a major role in achieving faster economic growth in future. This calls for a deeper analysis for developing the alternative sources of power generation, which could suggest an economically viable and optimal solution. In this connection, the need to explore the potential of 'non-conventional' energy sources, very vital and relevant.

The high construction cost of power units and the problem of un-interrupted supply of inputs (like coal), off late forced the planners to look for alternative source of energy. In general, it is accepted undisputedly that the thrust now should be on mini and micro hydel power projects and non-conventional sources particularly solar, because, in most of the parts of country, there is ample sun-shine almost throughout the year One of the estimate suggests that entire energy requirements of the country can be met provided proper technology developed to trap and use the solar energy. If harnessed economically, solar energy can provide a ready and environmental friendly alternative source of domestic fuel.

Wind Energy:

Wind energy is a viable alternative source of energy. The harnessing technology of wind energy is simple. The strike of the blowing wind on specially designed blades of windmill's rotor causes both to rotate. This rotation which is the mechanical energy when coupled to a turbine, drives the generator. This is most suited to the Indian sub-continent which is a high wind zone with energy potential

estimated at around 20,000 MW, according to Ministry of Non-conventional Energy sources.

Wind energy plant has a low gestation period of just about five months. Once the wind turbine is commissioned, generation starts and owner gets power free as the energy input is free of cost. This shows that wind power generator is economically viable project. On the contrary, in conventional source of energy generation, the hike in fuel prices increase the cost of production. Besides, maintenance of machinery and limited running time add to unit cost of power. The five to ten year gestation period of these system affects economical viability in the form of high opportunity cost, as investment is blocked for too long without results. In diesel power generation, along with price fluctuation, country has also pay price in terms of foreign exchange when most of the advanced technologies and heavy and sophisticated machinery is imported at internationally competitive prices. Following are the advantages of wind power energy plant over conventional system:

(i) Low gestation period
(ii) Cost free power after commissioning the plant
(iii) Flexible power supply as installing wind turbines is flexible as each generator's capacity is relatively small.
(iv) Cheaper power generation as less recurring and maintenance expenditure.
(v) Installing 1 MW wind power plant costs about Rs. 3.6 crores, with pay-back period is as low as seven years, with average life of 20 years. Cost of power generator is 40 paise per unit, almost one-third cost than conventional source
(vi) Capacity to serve the local needs in a more suitable way
(vii) A source of local community responsibility building
(viii) Environmental benefits.

Solar Energy:

Solar energy is a dependable, low maintenance, stand alone source of renewable energy in the region where sunlight is available during most of the part of the year. For this purpose, it is need to operate and install with solar photo voltaic power plants. The plant has arrays of solar modules in series, which is useful in meeting peak load demands.

One of the major difficulty to the commercialisation of photo voltaic is its high initial cost. But, continuos research effort has made it possible to reduce the cost from Rs. 1,200/- per peak watt (WP) in 1970 and stabilized around Rs. 160 at present.

This system is specially useful for rural electrification and can successfully supply power for lighting, community television sets and water pumping for drinking water and micro irrigation. India has great potential for solar energy, which is estimated of the order of $(5x10)^{15}$ KWHR/Year, but total energy generated through installed solar thermal devices at present is less than 130 million KWHR/YEAR till 1991-92.

Department of Non-conventional energy (DNES) has taken many steps to popularize the non-conventional source of energy. In year 1991-92, Department of Telecommunication install about 25,000 SPV systems for powering rural radio telecommunication system. In 1993-94, establishment of decentralized SPV power systems with array sizes ranging form 2 to 10 KWH, for water pump program and for solar lantern scheme (10.watt module with seven watt lamp).

Further, the Indian Renewable Energy Development Agency (IREDA) has recently come out with a scheme under which IRDEA would join hands with state governments and to private sector companies with a mandate to develop wind power estates in different parts of the country. In order to popularize the Wind-Power scheme, a significant share of total costs of scheme has been paying by the governmental agencies. The cost share holding pattern is triangular as 24%, 25% and 51% are shared by IRDEA, state government and the private sector respectively. As an incentive, accelerated depreciation allowed on equipment cost and facility of soft-loan-window.

Solar energy generates power which may be used for varied and wide applications. For example, PV lantern, rural radio telephone, shallow well pumping system, micro irrigation for farmers, deep well pumping system, power plants, micro-wave receiver stations, which usually on hill tops are alternatives for it's use. With all the above applications and many more are development stage. But it is evident that PV power is playing an increasing important role as a technical and economical source of energy for rural electrification. Hence, all efforts and incentives to promote the manufacture and use of photo voltaic power should be provided. Following are the advantages of solar power energy plant over conventional system:

(i) Low gestation period
(ii) Relatively easy construction and handling
(iii) Cheaper power generation as less recurring and maintenance expenditure.
(vi) Capacity to serve the local needs in a more suitable way.
(v) Enhances local awareness and community responsibility
(vi) More environmental friendly

Status of Renewable Energy Sources in North-Eastern India

About two-third of the total population of North-Eastern states of India lives in rural areas; less than 30% of it is concerned with the conventional power grid. About 60% of total rural population depend primarily on biomass and or endogenous sources of energy requirements. In this situation, the systematic development in the direction of energy supply to the rural areas would be:

(i) to meet social and economic needs,

(ii) to stop deforestation and desolation, and

(iii) to stop the rural exodus to big cities

In view of these needs and delineated general parameters, renewable energy technologies have an important role to play in the economic and social development of north-eastern region of India. Table-2 reveals some of the basic features of trends of power consumption in North-eastern region for the last twenty years from 1970-71 to 1992-93. The per capita power consumption is continuously increasing significantly in all the NE states. This shows a growing need of power consumption in this area. However, the level of per capita consumption is much lower that of 'All India' average, through out the twenty years period. This phenomena could be explained partially by low level of economic activities based on power in the North-Eastern area. In future, the scene is expected to change for better , then demand for electricity will grow faster and will further generate the scope for renewable energy sources in this region. Along with other states of India, the activities and encouraging policies of DNES, New-Delhi, are popularizing renewable energy technologies in N.E states.

Table-3 through 5, show the state-wise break up of renewable energy technologies installation till March'91. Biomass and solar energy sources are more popular in the region, where wind energy source is yet to develop. Sectoral use of bio-technologies are given in Table -3, Micro level family type biogas are installed, in the highest number in Assam, followed by Mizoram and Manipur. Nagaland and Tripura have least number of biomass plants. Biogas plant in the form of improved chulha (IC) is very popular in Assam and Meghalaya.. Whereas, IC scheme is yet to develop in Manipur.

Solar energy technologies are also picking up the ground in North- Easter India (Table-4) .Tripura and Nagaland are prominating in generating power through

solar power plants. But, Mizoram, Sikkim and Assam have been emerging on the map of the states, which utilize the solar energy for power generation. Solar energy is specially, being applied for street lighting, solar pumps, domestic and community lighting systems in the villages. Tripura and Meghalaya are the states which are most capitalizing the use of solar energy technologies. Solar energy can also be utilized for Water heating system. The 'Urja', a Water Heating System through solar energy is very popular in Meghalaya, followed by Mizoram. But Sikkim does not have, so far, any of the available technique for water heating either at community level or domestic level (Table-5). It may be concluded from above observations that the use of non-conventional sources of energy in North-eastern India is in its developing stage and there is much scope for improvement the qualitative and quantitative use of non-renewable energy sources in these states.

Major obstacles in the development of renewable energy sources are basically two: the lack of funds and the lack of public awareness about the technologies used for the purpose at ground level. The sufficient amount of empirical and technical data for planning and selection of appropriate locations for the projects are not available in most of the cases. There is a difficulty of social acceptance of these type of energy resources as a reliable and dependable energy sources. Most of the people even today do not consider renewable energy sources as a 'normal' source of energy. It is considered as something 'exotic' and 'artificial'. This is a matter , which is more associated with the education, belief and consciousness. For this purpose , there is an urgent need of a well designed policy frame work to educate the local people along with promoting the renewable sources of energy, specially, in the remote areas of the region .

In fact, a new policy is formulated by the Government of India to fulfill the need of energy in the country. Under this energy policy formulation, main emphasis is given to enhance the renewable energy sources which may replace the other traditional and un-economical sources of energy. Target is also fixed to ensure 'electricity for all' in next fifteen years. Efforts will also be done to ensure substitution of petroleum-based fuels with renewable energy. This would help in reducing level of environment pollution. Private sectors have been encouraging to increase competitiveness and to enhance the generation and use of the renewable energy resources . It means that the correct and proper policy measures would definitely provide a new thrust to develop non-conventional energy sources in NE region in particular and in nation as whole.

Conclusions

Growing the demand of energy and developmental activities in North-eastern part of India, it is soon going to face a situation of energy crisis in the form of power shortage. While the conventional/commercial sources of energy at present rate of growth would not be in position to meet the growing need of the energy, there is a need to develop a strong base of renewable energy supply system in the region. It would work as a support and complementary source to the conventional energy system. The present economic analysis indicates that there is a vast scope for this type of energy source in North-Eastern part of country where the raw material for them is vastly available. The suitable incentives and systematic development would make renewable energy as an attractive option with long term benefits of the people of the region

References

Das T.K., Chakorborty D., Seth S (1991): "Energy Consumption and Prospects for Renewable Energy Technologies in an Indian Village", *Energy*.

Govt. of India (1989) : Department of Non-conventional Energy Sources, New-Delhi. "Energy 2001 - Perspective Plan Non-conventional Energy Sources - 1987".

Dunkerley, Joy et. al , (1981): *Energy Strategy for Developing Nations*, John Hopkins University, Baltimore.

Eden, Richard et.al. (1981): *Energy Economics*, Cambridge University Press, Cambridge.

World Development Report, (1983): *The Energy Transition in Developing countries* World Bank, New-York

Tables

Table-1: Energy Supply Shortage : All India

Year	Energy (mu)	Shortage in %	Peak load (MW)	Shortage in %
1989-90	19.611	7.9	6.727	16.7
1990-91	21.072	7.9	6.834	15.5
1991-92	22.542	7.8	9.008	18.8
1992-92*	19.199	8.5	10.051	19.4

*up to December, 1992

Table-2: Per capita consumption of electricity in North-Eastern Region (in KWH)

State	Arunachal Pradesh	Assam	Manipur	Meghalaya	Mizoram	Nagaland	Tripura	All India
1979-80	-	24	5	-	-	8	5	90
1980-84	15	34	6	31	7	32	13	135
1984-85	32	46	26	61	24	65	25	167
1985-86	32	53	34	76	32	67	28	178
1986-87	34	51	48	83	26	56	29	191
1987-88	45	71	60	84	41	65	35	203
1988-89	55	63	57	98	49	67	41	216
1989-90	58	78	80	108	57	70	51	236
1992-93	12	91.0	140.4	159.4	126.1	100.0	83.9	330.6

Source: The Power Scenario. New Delhi, April. 1991

Table-3: State-Wise Break up of Bio Renewable Energy Technologies Installations (upto 31.03.91)

	Manipur	Meghalaya	Mizoram	Nagaland	Sikkim	Tripura	Assam	Arunachal Pradesh
Biogass CBP/IBP/NBP	-	-	-	-	-	-	1	-
Family type biogas plants	416	219	711	124	539	164	9748	52
Biomass gasifiers	-	2	-	1	-	-	-	2
Improved chulhas	2150	10200	7694	7000	18597	5971	101357	6042

Source: Basic Statistics of North-Eastern Region, 1995. North- Eastern Council. Ministry of Home Affairs. Government of India. Shillong.

Table-4: State-Wise Break up of Solar Energy Technologies Installations (upto 31. 03. 91)

State	Street lighting no of villages	Solar Pumps	Community lighting system	Domestic lighting	Power Plant (KWP)
Manipur	30	2	-	-	4.00
Meghalaya	25	25	-	210	2.50
Mizoram	41	7	1	85	-
Nagaland	38	15	3	8	6.00
Sikkim	28	2	3	20	-
Tripura	52	113	122	225	11.70
Assam	20	69	-	-	-
Arunachal Pradesh	30	14	14	50	2.00

Source: as of Table-3

Table-5: State- wise Break up of Water Heating Technologies Installations (upto 31. 03. 91)

State	Urjasrams	Solar	Domestic	Solar stills
Manipur	-	200	12	21
Meghalaya	-	732	2	-
Mizoram	-	70	-	-
Nagaland	-	-	-	-
Sikkim	-	20	9	-
Tripura	2	-	-	25
Assam	-	-	-	56
Arunachal Pradesh	-	-	-	20

Source: as of Table-3