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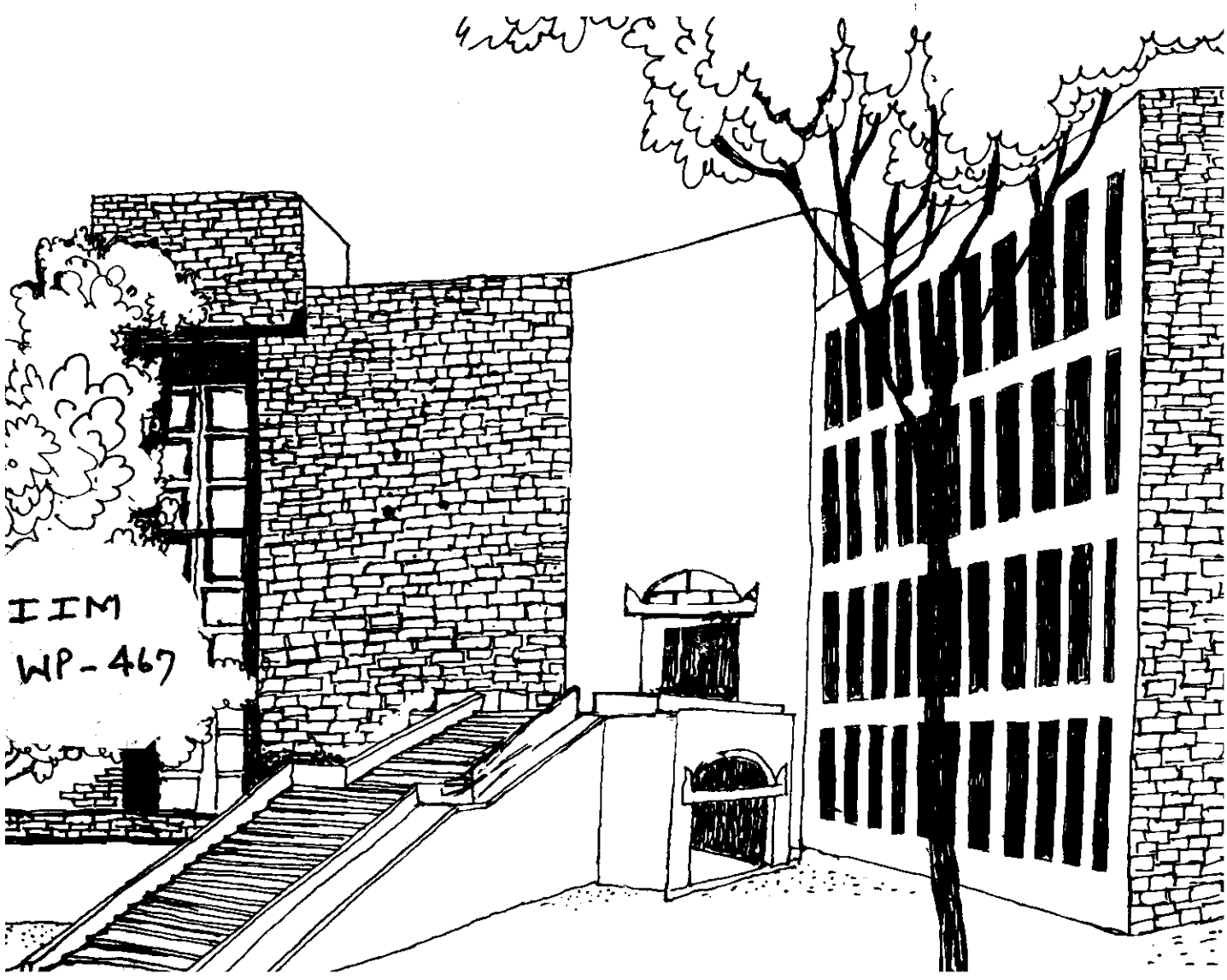

COMMERCIALIZATION OF RENEWABLE ENERGY TECHNOLOGIES : SOME POLICY FRAMEWORK

By

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COMMERCIALIZATION OF RENEWABLE ENERGY TECHNOLOGIES : SOME POLICY FRAMEWORK*

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Introduction

As a mixture of sheer economic considerations and a preference for social value for a particular life style, renewable energy technologies are actively promoted in the world at large, particularly in the Third World developing countries. Among all the developing countries, India's efforts in this field perhaps stand out as critical, not only because of her size or political importance or economic problems vis-a-vis fossil fuel crisis, but also due to the sincerity and seriousness in her attempts. The level of personal attention given to this activity by the highest political authority of the country, the Prime Minister, inclusion of this activity as one of the major items in the 20 point programme and more recently the creation of a separate Ministry and the suggested Energy Commission demonstrate eloquently India's seriousness and the Government's determination. It therefore is extremely important and right in time to analyze some critical future policy options for India, particularly in relation to commercial viability of these technologies in the market place. For, in the ultimate analysis, just as the 'test of a cake is in eating', the success of the promotion of new and renewable energy technologies is bound to be determined by their marketability.

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Market Place:The Determining Factor

In our burst of enthusiasm it could be a dangerous delusion to treat renewable energy planning as a matter of merely generating and installing hardware. In actual practice, promotion of renewable energy technologies really amounts to offering choices to people as against their existing practices and behaviour. The fact that often the choice for new and renewable energy technologies is likely to be for a wildly different from what is already in there, it is bound to be extremely difficult, slow and hard-calculating choice in which economic considerations would play vital role. Thus, it is possible to assume that renewable energy options are likely to become popular when planners and manufacturers (entrepreneurs) find ways to overcome economic problems as effectively as technical problems. In other words, what is emphasized here is a well-known but often overlooked hypothesis that renewable energy policy and planning cannot be looked in isolation of the realities of the market place.

Now, let us examine some of the assumptions of the promoters and planners of renewable energy technologies. Most of them seem to be convinced that time and economic forces are on their side. They argue that energy prices will continue to rise, and high-technology machinery consuming high commercial fuel will remain expensive and inappropriate for many developing countries. As a result, a remarkable collection of new products emerged during the past decade to meet the special energy conditions of developing countries. The products include small-scale farm equipment, windmills,

solar devices, pumps, food processing machinery, processing of biomass including biogas plants. Manufacturers of these products hope to fill the product gap between high fuel-energy consuming products and primitive low fuel energy consuming processes. Many of these entrepreneurs are convinced that these alternative renewable technologies can sell big and will prove compelling in the market place. And they put a rider in their assumptions and perhaps rightly so, that it can sell big if consumers and governments give them a try.

In spite of these robust assumptions, many of the entrepreneurs and government planners say that the going has been slow. It seems there is a big problem in developing proper linkages between the people making and promoting the new and renewable technologies and those who need them. To repeat the cliche', the fundamental theory of product marketing is to tie up the product to a real need of the person - a real, specific, factual benefit. In other words, one must know the consumer very well before one starts talking about it to him. Simply by assuming that the new and renewable energy technologies are addressing society's major unmet needs, would neither promote its commercialization to a sizeable market segment nor would it develop into a profitable business opportunities. On the other end of the linkage, it seems to be equal ly important to understand that it is the existence of a large market that can allow entrepreneurs and government to allocate proper level of resources for necessary development of support infrastructure.

Lessons of History

At this stage, perhaps it is in order to look into the historical evolution of the energy mix, in order to answer the despair and frustrations of many entrepreneurs and planners. Basically, the problem concerns the introduction of new technology into society, a problem not correctly perceived by many. The new and renewable sources of energy are after all different technologies fighting for the energy market. If we examine the history of rate of market penetration of a widely different products and technologies in widely different markets like USSR, USA, and Japan, two important factors become glaringly conspicuous:

1) The market is generally extremely slow in accepting new things. It is observed that it takes about 50 years in USA to reach a takeover time, i.e. to go from 1% to 99% of the market.

2) There is extreme stability of the functions over very long periods of time, including all economic or political disturbances.

Similarly, we seem to have forgotten or overlooked the historical truth that it took almost 100 years for the oil industry to fight back and conquer the black-diamond, coal.

The lessons of the history seems to be clear now. Since the takeover time in terms of market penetration are in the order of 50-100 years, there is not much reasons for getting frustrated and disturbed, but a meaningful influence in the whole process can be obtained only through a long range planning. On the other hand, it is apparent that the spreading of a new

technology almost always follows the rule of penetrating first into small favourable market segment, acquiring force and momentum for the next step. Thus, the appropriate commercialization strategy of renewable energy technologies should be to concentrate on the special case, the special product and a favourable market segment in the short run in order to hasten the takeover time in the longer run.

The thing to remember is the fact that if two systems compete for the same market, the one with higher economies of scale in generation and transportation is the most likely to win in the long run if the intensity in use increases. This is the basic mechanism behind the substitution of wood with coal and later coal with oil and gas. To illustrate the point, wood has little economies of scale in collection and transportation, and poor transportability. It can be then naturally competitive in low density markets, with short distances to be travelled. To make it adaptable to the large market, it is essential to raise its transportability, collectability and density of use. Low spatial density of use of a commodity makes small economic, and perhaps beautiful, whereas high density optimizes with the big, if ugly. This seems to be the basic economic law, even if the protagonists of 'small is beautiful' feel otherwise. If we are aiming for higher density of energy use in future, which we must, high transportability and larger scale of economies for renewable energy technologies must be considered as a long-range planning objective, - a process which would call for modernization of technology and centralization. So the choice will be between different technically possible levels of centralization.

For the present, however, we may argue that given the windfall of energy crisis, the historical process of shift from one energy source to the other is likely to be shorter and with the government support the favourable environment for renewable energy technologies can be exploited for better purpose. But the availability of a technology is not a proof for fitness in the market place, even if there is the windfall of super energy crisis. How much can we hope for commercial prospects of renewable energy technologies will depend upon the characteristics of the market segments of the consumers and their needs, as well as the reliability and economics of the available technologies.

The Energy Market

There has been a number of projections about the energy needs and gaps for different sectors of India's economy and for different and uses. For the purpose of this article, it is instructive to point out some basic trends in these data on present levels of energy consumptions.

Table 1: Sector-wise and End-use-wise Fuel Energy Consumption Pattern and Needs

Sector	End-use-wise Energy Consumption Needs			
	Domestic	Agriculture	Industry	Transport
Rural	High	Medium	Low	Low
Urban	Medium	Low	High	High

Let us consider two broadly classified sectors of the economy, rural and urban. In the rural sector, we find fuel energy consumption need is highest for domestic purposes of cooking and heating, which is largely met by the

so-called non-commercial biomass energy sources. Following energy needs for domestic purposes, is agriculture in rural sector. In agriculture, the major fuel energy use is in the pre-harvest operations, such as fertilizer, land preparation, irrigation and harvesting as against the post-harvest operations like drying,threshing, storing, processing and transporting. Industry and transport in rural sector are relatively low in demand for fuel energy use at the present level of development. The urban sector, on the other hand, presents a completely different and opposite picture, in which industry and transport are the highest energy demanding activity and mostly fuelled presently by the commercial energy. Interestingly, domestic demand for fuel energy in urban sector, although not as high as in industry and transport, is almost 50% dependent on non-commercial fuel energy.

It is possible now to anticipate a scenario of future energy needs and gaps if we superimpose on the present consumption patterns, as discussed above, the trends of growth and development in various sectors and end-uses. It is quite legitimate, for example, to anticipate much higher demand of fuel energy use in agriculture, particularly, for purposes of irrigation, fertilizer and post harvest operations. In fact, World Bank report clearly anticipates much higher energy input in agricultural system without proportional increase in agricultural output, unless there is another genetical engineering breakthrough in plant science as it happened in HYVs. Similarly, for a developing country like India, the industry and transport in urban sector would place increasing demands on fuel energy sources in order to maintain, if not to increase, the pace of development and productivity.

The foregoing analysis of broad trends are merely indicative of the potential demand structure vis-a-vis the supply, i.e. demand-supply gap at a macro level. While it does give a broad trends and indications, it fails to give the critical element for commercialization policy for renewable energy technologies, that is, the characteristics of various market segments and their specific consumer profiles. There is hardly any data on a sufficiently detailed and large scale basis to tie the product with consumer profile, - a basic necessity for commercialization process. However, short of such data, one can only hazard to present certain trends on the basis of limited experience. Following are some critical observations made during a recent detailed survey of 20 villages in Bihar and Punjab in connection with a World Bank sponsored study:

> Firstly, the notion of non-commercial nature of fuel-energy sources, such as, firewood, agricultural wastes and cowdung are slowly disappearing. In fact, in many villages, these energy sources are gradually developing into a priced commodity in commercial sense, may be still embeded into barter or kind-wage system with imputed price.
>
> Secondly, due to deforestation and for other related reasons, collection of firewood and agricultural wastes are increasingly becoming difficult and time-consuming operations cutting into wage-labour hours.
>
> Thirdly, given the opportunity cost of labour and lack of alternative economic uses in rural areas, fuel energy sources particularly for domestic and for some agricultural operations are perceived to be obtainable at a very low or even zero private cost. Any alternative fuel energy, is, therefore, evaluated by these consumers against this low level of opportunity cost.

Fourthly, with the rapid growth of agriculture as in the Punjab, the energy-intensity rises in pre and post-harvest operations in agricultural production and marketing systems, leaving enough surplus of biomass for domestic consumption. Often, disposal of agricultural wastes become a problem and uneconomical propositions in the lack of alternative economic uses of these wastes.

Lastly, but perhaps most important in relation to our basic issues of commercialization, is the fact that people seem to be least motivated or concerned about appeals that something like renewable energy technologies are good for them and for the country. What seems to appeal to them is in terms of specific benefits that renewable energy technologies can bring to them, how it fits into their life style and what sort of problems it solves.

Stages of Commercialization: An Assessment of Some Renewable Energy Technologies

Given these broad parameters of the consumer-client system, what is the prospect and potentialities of commercialization of available renewable energy technologies. For the sake of brevity and space constraint, let us consider here the potentialities of five most commonly-talked about renewable energy technologies: biogas plants, windmills, solar devices (not photovoltaic cells), energy forests and micro hydel power. The overall assessment of these technologies in terms of the stages of commercialization is presented in table below:

Table 2: Rating of Stages of Commercialization of Renewable Energy Technologies

Technologies	End-uses	Stages of Commercialization
Biogas Plant	Domestic (cooking, heating)	High
	Pumping water	Medium
	Lighting	Medium
	Power-Generation for industrial uses	Low
Energy Forests	Firewood fuel (domestic)	High
	Thermal Power (lighting industry)	Low
	Pyrolysis (charcoal etc.)	Medium
	Ethanol (liquid fuel)	Low
	Producers gas for pump	Low
Wind Mills	Water Lifting	Low
	Power Generation	Low
Solar devices (not photo-voltaic)	Domestic (solar cooker)	High
	Water-heating (domestic and industrial)	High
	Thermal Power	Low
	Drier (agricl. use)	Low
	Refrigeration	Low
Mini and Micro Hydel	Power Generation	Medium

Let me briefly elaborate the above assessment of the renewable energy technologies. Among the above mentioned five technologies, biogas plants and energy forests are clearly at a much relatively higher stages of commercialization process. It is obvious that in many remote villages in India, the costs of connection to the nearest central electric grid are prohibitive. For some areas, in fact, biogas may represent the only viable technology, whether or not the gas burned directly or converted to electricity. As observed elsewhere, with the present stage of technology and its constraints of minimum number of cattle-holding requirement, the market segment for individual biogas plants in India constitutes about 15 million rural households. This is indeed a sizeable market for a profitable business proposition and

commercialization of a product. Added to these are some urban market segment, particularly, in rural-urban fringe areas, which still remain to be assessed and exploited. Apart from the individual family plant for domestic use of directly burning gas, there is also quite a sizeable market for large-size plant especially suitable for large farmers, organized livestock farm, and other institutions, which can effectively use gas for pumpsets, engines and generators. In these large size plants, there can be problems of costs, social constraints and servicing and maintenance, which should have to be overcome. But, it is clear that there is a scale of economy in large-size plant and such systems that sell gas at half the equivalent price of diesel fuel perform fairly well in terms of commercial and economic viability. Making energy available at half price of diesel fuel equivalent is certain to attract farmers for irrigation and small scale processing industries. It is often suggested that a large scale popularization of biogas in rural areas in India may seriously hurt the interests of the landless cattleless people. As I have argued elsewhere, this fear is exaggerated in the sense that it cannot be proven on the basis of actual village data. On the other hand, the limited factual data show that the dependence of the poor on cowdung is not as much as is often thought of and their share in cowdung is not likely to be reduced due to biogas promotion. Nevertheless, it is a fact that biogas technology cannot reach the poorer sections of the population, except through centrally managed large-size system. Be that as it may, biogas technology is certainly at a relatively higher stage of commercialization, particularly, in view of its capability to address to some specific benefits to the consumers. It is a different

matter that as a marketing strategy it will have easy penetration to that segment of consumers who have certain level of resources and for whom alternative fuel availability at zero private cost is no longer tenable and/or the alternative fuel has become costly or difficult to obtain.

The primary aim of energy forestry or social forestry is the development of firewood resources, the supply of fodder and small timber and the stabilization of both hydrological and soil systems. In some states, particularly, in Gujarat, the programme has caught on successfully and has proven its economic and commercial viability, particularly, Eucalyptus plantings, which has overwhelming dominance in any case. It is reported that while cost of mixed and rotation cropping of traditional food crops in rainfed areas requires an annual expense of at least Rs 600 per acre, Eucalyptus plantations require only an initial expenditure of Rs 600 per acre once in 30 years and a guaranteed rate of annual return of Rs 2,500 per acre at a selling price of Rs 600 per tonne. Obviously, then the commercial viability of energy forests is proven beyond doubt. But it seems that the picture is not as clear as is made out to be. Firstly, the programme has become convenient means for landed farmers to be independent of labour in their farm operations while simultaneously increasing the return from land. Secondly, as a result of high market price for Eucalyptus for pulp-based industries and for supporting legs for building activities, there seem to be impressive growth of Eucalyptus plantations in the villages. Thirdly, since most of these plantations have been on private land, often substituting food crops, the produce is obviously not available freely. Neither the farmers growing Eucalyptus use its wood as domestic fuel because of higher economic returns on the sale of the wood. It therefore remains to be more a commercial

exploitation of forestry for other than energy purposes. The concept of energy forests is still to be realized. But the technology has been well established and with proper policy measures and organizational interventions, its energy potentiality can be fully utilized on commercial scale. Perhaps, using part of the wood as raw materials for further processing into energy fuel, such as, thermal, pyrolysis, producer gas etc. could explore the potentialities fully.

Wind energy efforts began in India with the importation of multiblade water pumpers from Australia and other countries. Presently, several government institutions and private manufacturing organizations are involved in developing suitable models. By its very nature, this is a very location-specific technology requiring some critical minimum conditions. This means, narrowing down its market size. At the present stage of development of available technology, its relatively high initial cost, its limited market size and almost proven technological reliability under different conditions, wind mills have not reached a stage of commercialization beyond pilot testing. What is needed at this stage, apart from suitable technological modifications and development, is a close scrutiny and evaluation of the early work in terms of performance, support systems, economic assessments by a competent authority other than the agencies or manufacturers involved. For, such assessment should necessarily be completely unbiased and needs to be done from the point of view of the users or client system. The market and local industrial capabilities also must be understood before a local production scheme in commercial scale is undertaken.

Solar devices, particularly, photovoltaics are said to be the energy sources for future. However, at the present stage of development, and its prohibiting costs, photovoltaics remain far beyond the reach of the individual consumers. The best current market for photovoltaics is industrial applications, which is mainly funded by the government or donor funding agencies. On the other hand, there are several applications of solar flat plate panel technology currently available in India which have commercial potentialities both in urban and rural areas. The solar cooker, despite its limitations and constraints, can attract some segments of the urban and rural consumers. Similarly, solar hot water system can be a viable commercial proposition both for domestic as well as for some industrial processes. Solar drier can have a commercial application for crop drying, if it can be organized in a centralized or cooperative custom-hiring basis.

Lastly, the mini and micro-hydel power is an available technology in India whose potentiality has yet to be fully harnessed with proper data base. Its limited use in a particular geographical location needs to be properly mapped out. Financing such projects must necessarily come from Government or donor financial agencies. Small scale hydropower if properly planned as in China, can be a viable commercial proposition for renewable energy technologies.

Policy Issues

Having assessed the commercial viability of some of the available renewable energy technologies, it is now possible to indicate some important policy options for augmenting the process of commercialization:

1 Incentives and Support System

It is a fact and perhaps quite logical to expect some incentives, especially financial, and a proper support infrastructure for rapid commercialization of renewable energy technologies. The government's role for instituting subsidies, tax concessions, bank credit facilities and easy raw material supply on easy terms for manufacturing and promoting these technologies should have to be looked into in this light. However, a government subsidy cannot be a permanent feature even after a product establishes itself commercially in the market place. On the other hand, rate of subsidy cannot and should not be universal irrespective of the economic power of the customer. Thus, depending on the stages of commercialization of a particular renewable energy technology, a sliding scale of subsidy needs to be worked out, which should have to be reviewed after a suitable time period for eventual withdrawal in the long run. Similar exercise is also applicable for interest rate on bank loan and maturity period for different economic categories of customers.

2 Role of Government and Private Entrepreneurs

The interface-roles of the Government and private entrepreneurs needs to be reinforcing in terms of policies and actions in the process of commercialization. This means, the supporting policies of the government

must encourage and facilitate the private entrepreneurs in achieving their legitimate commercial success. On the other hand, the private entrepreneurs need to be regulated by the Government to maximize the national goal envisaged by the government policy. In operational terms, as and when a particular renewable technology is assessed to have reached a viable commercial stage, its commercial potential should be allowed to be utilized fully in the market place through private entrepreneurs, public semi-autonomous corporations and by voluntary development organizations within the broad frame of government policies. Small size individual biogas plants, solar cookers and energy forestry seem to have reached such stage where government interventions are least required, except in the case of energy forestry where some regulatory methods are required to focus its energy objective.

3 Pilot Plants

Field testing of renewable energy technologies, which are yet to reach a proven feasible stage for commercialization is a paramount necessity. Such a testing often requires large capital expenditure and other support infrastructure. Windmills, industrial application of solar devices, large-size biogas plants and small-scale hydel power are some of the examples. Government has to play a major role in encouraging and setting up such pilot projects through private or public enterprises either as an active or a collaborative partner. A large part of financial responsibility may have to be borne in most cases by the government.

4 R&D Linkages and Evaluation

Contrary to general belief, renewable energy technologies are not necessarily simple and inferior technologies. A constant flow of R&D is absolutely essential to update and diversify these technologies. R&D is usually an expensive activity, beyond the means of small manufacturers and private entrepreneurs. While major responsibility of R&D should lie with the government and government laboratories, there should be two-way direct feedback linkages of information flow from the entrepreneurs, promoters and manufacturers to make the R&D problem-oriented and practical. This does not mean that the private enterprises can and should dispense with fully their in-house R&D. Within the R&D system, an important element should be unbiased competent economic evaluation of the technologies, which is often overlooked, but is an absolute necessity as a continuous process. Such evaluation as an integrated part of the R&D system needs to be done by an independent authority for greater reliability and unbiasedness. This can be jointly commissioned by the government and manufacturing/promoting organizations. In fact, such evaluation can be a proper guideline for assessing the necessity for import policy of those technologies and/or joint venture foreign collaboration efforts.

5 Demonstration Projects

Something is a good machine cannot be proven without letting people see how it works and what the results are. For renewable energy technologies, this is by far the most effective marketing strategy. Both the government and private enterprises should have a firm policy for setting up demonstration projects. While the government can actively encourage its own

organizations and institutions to instal these technologies, the private entrepreneurs may motivate individual, private organizations, institutions and industries for such purposes. For large-scale biogas plant, for example, TERI suggested the cooperatives as a potential organization for such purposes. It should be noted here that a demonstration project in a government set up and in a private set up has differential demonstration effect on private citizens. For commercialization process, a successful demonstration in a private set up is likely to be more effective.

6 Trained Manpower

For commercialization of renewable energy technologies, there is the necessity process of demonstration, adaptation, training for installation repair and maintenance. This means creation of an army of skilled manpower of technology corps available both in rural and urban sector. While government should support such technical training programme as a manpower planning process both in its regular educational establishments as well as in the form of in-service training programme, the private entrepreneurs and manufacturers must also devote some resources towards this direction for their own survival and effectiveness.

7. Access to Media

Apart from actual demonstrations, use of various mass media including trade fairs as sales techniques is hardly a new marketing technique, but it often works. At least it creates awareness and sensitizes large number of people enough to spread messages through word of mouth. There must be a coherent planned programme for such media exposures with suitable developed media-materials.

8 Relevant Data Generation and Planning

The commercialization of renewable energy technologies can be effected only through a process of long-range planning based on reliable information base. The application of renewable energy technologies must be conceived as part of integrated energy planning process. It cannot be and should not be planned in isolation. This means, for rural areas, an integrated energy planning for a particular area or region. Similarly for urban or industrial sector, it should be a part of total energy planning according to the needs. To accomplish meaningfully such planning task, micro level data on region or area basis, and similarly industry-wise basis is absolutely essential. For, not all processes and uses can be effectively substituted or replaced by renewable energy technologies, neither would it be possible or even desirable. A rational and useful mix of energy technologies is required to maximize the effectiveness and the benefits. The responsibility for such data generation should be both for the government and private entrepreneurs.

Conclusion

In this article, I have merely tried to indicate some of the major policy implications for commercialization of renewable energy technologies. This is not an exhaustive list, neither is it intended for. What it indicates, however, is the enormity of the task and its complexity. As the history tells us, not all the renewable technologies will survive in the reality of market place. Some will, provided there is enough policy support in right directions, without which none may survive even if there is super energy crisis.