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ELECTRICITY FROM RENEWABLE SOURCES: AN AGENDA FOR DEVELOPMENT

by

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1.0 Introduction

Human beings require energy for various end-uses. Ability to use energy sets apart man from all other animals. Most important among these end uses are: motive power — for transport, for driving machinery etc. — heat — for space heating and cooling, cooking, drying etc.— and light — for lighting. The energy forms that occur in nature, however, are not suitable for direct use and, generally, need to be converted to more versatile forms of energy before use. There is no doubt that the most versatile form of energy is electricity. Generation and consumption of electricity and its use has become vital to the functioning of modern societies. Traditionally, electricity was produced by conversion of the chemical energy that is generated from fossil fuels—coal, oil, and natural gas, the potential energy of a body of water (hydro), and, to a lesser extent, the nuclear energy associated with atoms. Oil crises and sudden oil price increases in the seventies changed this tradition, and created a need for the development of alternative energy technologies. These included the production of electricity from biomass, direct solar radiation, wind energy, hydro resources, ocean and tidal energy. The renewable energy development effort gained momentum in the eighties because of environmental concerns, notably, green house gas emissions and acid rain. Awareness that the resources are not inexhaustible and the concept of sustainable development added further strength to the development effort.

Almost every country has renewable energy sources that can be harnessed to provide energy in useable forms for meeting various needs of its people. In many parts of the world, renewable energy systems are already contributing significantly to the supply of energy. This paper discusses the historical development, present status, problems and issues, strategies, and an agenda for development of renewable energy sources in Sri Lanka.

2.0 Cost of Electricity from Renewable Sources

Renewable sources of energy, usually referred to as renewables, are energy sources that do not get depleted over time. Hydro power, a renewable resource, has been a significant power source of many power systems in the past. However, the development was mainly confined to large-scale schemes, and the small scale schemes started receiving attention only recently. Development of renewable energy systems was vigourously pursued by many countires after the first oil crisis. Technological advances in the last two decades have made the smaller schemes in the kilowatt range cost effective. The cost is site specific, but there is an abundance of schemes with unit generation costs of less than 4 USCents/kilowatt-hour(USCents/kWh). Some of them have reached the stage of commercial viability, at least under certain circumstances. Among them are wind, solar and biomass. Commercial viability of Ocean thermal (OTEC) and wave energy systems have yet to be established. Of the other renewable technologies Wind is the most promising. United States National Renewable Energy Laboratory has estimated that in the United States, the generating cost of wind energy systems has fallen to 6 USCents per kilowatt- hour (USCents/kWh), at present, and it has predicted wind electricity cost to fall to 4 USCents/kWh by the year 2000. NREL's estimate of the present cost of electricity from solar photovoltaic systems is about 15 USCents/kWh and it is expected to drop to around 10 USCents/kWh in the next century. According to a study by the World Bank (Technical Paper No. 240), the cost of biomass generated electricity is site specific, and also depends on the cost of biomass. It is generally low when the fuel is a waste product and is competitive in cogenerating systems, for example, in sugar industry; however, this is not so when the fuelwood is purpose grown. Ocean thermal energy conversion (OTEC) and

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wave energy systems have not yet progressed beyond the experimental stage. Technical feasibility and commercial viability of low temperature solar applications such as solar chimneys and solar ponds have to be proven. In view of the above cost considerations, the ensuing discussion will be confined to hydro, wind and solar technologies.

3.0 Sri Lanka's Energy Resources

No deposits of coal have so far been found in Sri Lanka, though it is known that some peat deposits occur at Muthurajawela area near Colombo. Oil explorations have been conducted without much success since the seventies and there are no indications of any natural gas deposits. Uranium has not been detected in any sizable quantity. However, the country has a comparatively high hydro potential, abundant solar energy and a modest wind regime.

3.1 Hydro

Sri Lanka's rainfall pattern is governed by the monsoons. It experiences two distinct rainy seasons fed from South-West and North-East monsoons that are active from May to September and November to February respectively. Past rainfall and riverflow data, for the major rivers and tributaries, are available for a period in excess of forty years. The existing database of hydrological data is adequate for most potential assessment studies.

The country has over 100 river catchments but the climatic and topographical conditions are such that only 7 of these have potential for major hydropower development. These rivers are: Kelani, Mahaveli, Walawe, Kalu, Ging, Nilwala, and Maha Oya. The hydro-electric potential associated with major hydro-schemes are those of Kelani, Mahaveli, Walawe and Kalu rivers. But more potential remains, especially, in Mahaveli in its tributaries Kotmala Oya and Uma Oya, and down-stream of Laksapana in Kelani. During the Masterplan Study concluded in 1989, the remaining hydro-power potential in the country was estimated to be about 870 MW. For this estimate, only sites whose potential was more than 5 MW and capable of generating electricity at a long-term average cost of less than 15 USCents/kWh were considered. These projects which require the development of 27 sites are capable of generating 3680 GWh per year under average hydrological conditions.

No systematic country-wide study of sites with potential less than 5 MW has so far been conducted. However, a study of twelve randomly selected mini-hydro sites was carried out during the Masterplan Study. These projects have a capacity of 54 MW and an average annual energy potential of 232 GWh. It is a clear indication that very attractive mini-hydro sites are available for development. Though an inventory of sites with capacities under 500 kW is not available, it is known that more than 500 small hydro power plants were operating in the plantation sector before the advent of the natural electricity grid.

3.2 Wind

Sri Lanka's wind regimes are characterized by the monsoons. The South-West monsoon produces strong winds in most parts of the Dry Zone, while winds during the North-East monsoon are comparatively weaker and are felt mainly along the North-Eastern coastal belt. Sri Lanka also experiences well-developed sea and land breeze which tends to augment the strength of the monsoon winds. Throughout the country, the Department of Meteorology maintains approximately 15 meteorological stations that measure daily average speed and direction of the surface winds at 3-6 meters above ground level. They also maintain four stations that measure upper air wind speed and direction four times per day at up to 10 meters. In addition to these, approximately 20 agricultural research stations collect surface wind data at 3 meters.

Between 1990 and 1994, the CEB collected hourly wind speed and direction data at 10, 15, and 20 meters above ground level from twelve monitoring stations with standard lattice towers. This was the first detailed investigation of the Sri Lanka wind energy resource focusing on the potential for utility scale electricity generation. The monitoring sites were distributed throughout the Southern lowlands of Sri Lanka along the coast and inland from the coast.

Data from these monitoring stations form the primary basis from which the performance of wind power projects can be estimated at present. Analysis of the data for the Hambantota monitoring station carried out during the wind feasibility study shows that the ten year average wind speed is 5.7 m/s with annual average speeds varying from 5.6 to 6.1 m/s. Analysis of the monthly average wind speeds shows that the lowest wind speed are recorded during February to May. Table 2 The diurnal wind speed pattern indicates that the peak wind speeds occur between 2 o'clock and 4 o'clock in the afternoon.

3.3 Solar

Being a tropical island, adequate sunshine is available throughout the year. The average temperature varies between about 23°C and 29°C except in some parts of the central mountainous region, where the average is about 20°C. The solar radiation data available for 16 locations throughout the island, as provided by the Department of Meteorology, indicate a remarkably uniform annual average value of about 18 Megajoules per square meter per day (MJ/m^2 /d). However, a clear demarcation could be drawn between the wet and hilly south western quarter and the flat dry zone. About 16-18 $MJ/m^2/d$ may be applicable for areas above 300 m in the mountainous region and 17-20 $MJ/m^2/d$ for the flat dry zone. Sri Lanka may be considered to have a good solar resource.

3.4 Biomass

Biomass, inclusive of fuelwood and agro-waste from forest, is now providing the largest share of energy in Sri Lanka. The Forestry Master Plan for Sri Lanka (1986) estimated the supply of fuelwood at 11.4 million tonnes per /annum, and no significant change in the supply is expected up to the year 2000, though regional deficits may occur. The supply and demand balance for the whole country is likely to remain positive till the year 2000. A subsequent study by Mick Howes took an account of fuelwood and other biomass fuel for cooking purposes and arrived at the estimate of present annual potential biomass supply to be 16.5 million tonnes. It has been suggested that approximately, 600,000 hectares of unused marginal lands scattered throughout the country can be used for growing fuelwood for electricity generation.

4.0 Present Status

4.1 Hydro

Hydro power development in Sri Lanka commenced early this century in the plantations sector. Kinetic energy of falling water was harnessed, initially, to drive hydro turbines and later to drive generators. In 1918, D J Wimalasurendra, presented a visionary paper entitled "Economics of Power Utilization in Ceylon" at the Annual Sessions of the Engineering Association of Ceylon, as the Institution of Engineers, Sri Lanka was then known. In it he proposed the development of large hydro power resources of the country to provide cheap electricity for industry, railway electrification and rural electrification. Though his proposals found ready acceptance, their implementation was slow. Wimalasurendra's dream was realized in 1951. The first major hydro power scheme, Laksapana Stage I, was completed dawning an era of hydro-based cheap electricity. From then onwards, hydro power development and the extension of the electricity grid in the country were rapid. With the expansion of the grid, small-scale schemes in the plantation sector fell gradually into disuse. However, ever increasing price of electricity and the paucity of economical sites for large-scale hydro power development have renewed interest in small-scale schemes.

Sri Lanka has already developed 1115 MW of installed hydro capacity in major schemes, capable of providing 3869 GWh per year under average hydrological conditions. Contracts are shortly to be awarded for the construction of a 70 MW power station at Kukule harnessing the potential of a major tributary of Kalu Ganga. It is scheduled for completion in the year 2001. A 150 MW power development, to tap the potential of the upper reaches of Kotamala Oya, is awaiting environmental clearance. Feasibility studies for a power station at Broadlands, below Polpitiya power station in the Kelani river, have been completed. Prefeasibility level studies for tapping the potential of Uma Oya have also been completed.

Three mini-hydro power stations — Inginiyagala, Uda Walawe, and Nilambe — with an installed capacity of approximately 20 MW and an average annual generation of 47 GWh are in operation. About 60 micro hydro power stations operate in the plantation sector. They run as stand-alone systems, and are not synchronized to the grid. In 1993, the Ceylon Electricity Board announced that the Board would allow grid connection of privately owned small power plants. Subsequent to this announcement, three micro-hydro power plants ranging in capacities from 75 kW to 750 kW have been synchronized to the grid.

4.2 Wind

Wind Energy for water pumping has been used to a small extent since early seventies. An experimental 5 kW wind generator was installed in Pattiya pola about 15 years ago. Subsequently, attempts have been made to use wind-driven generators for battery-charging. However, these early attempts have not been very successful. So far no wind power plant has been grid connected.

4.3 Solar

At present about 5000 solar home systems (SHSs) are installed in the country. These systems have been delivered by the utilizes, government agencies, private suppliers and non-governmental organizations (NGOs). Ceylon Electricity Board (CEB) undertook marketing of SHSs in 1980. Up to now, they have sold close to 700 systems. The project was seen as a prelude to such systems being marketed by the private sector. CEB also experimented with SPV based battery charging stations. It had only limited success, mainly due to organizational problems at the village level. It is understood that about 1000 home solar systems were installed during 1989-1991 under a major project by a government agency. Funds for the project were provided by the Government of Sri Lanka and a donor government as a mixture of grants and soft loans.

Private sector companies have been active in marketing SHSs since 1980. They have been able to market about 1000 systems so far. In 1987, a local company established a manufacturing operation to assemble SHS. They also pioneered the hire-purchase systems and the loan schemes to make the SHSs more affordable. They have sold some 2000 systems in the last three years, of which about 60% have been sold to people for upgrading their battery lighting systems.

Two non-governmental organizations (NGO) have been involved with the dissemination of solar technology. Both NGOs used grant funds, foreign and local, to form revolving funds. One NGO used its existing organizations at the village level to provide loans to its members to purchase SHSs. It employed a local company to supply the systems and trained the technicians. The other NGO assisted in the creation of a village cooperative for managing the solar electrification scheme.

5.0 Problems, Issues and their Resolution

5.1 Major-hydro

Though this paper is not concerned with major hydro-electric power development, the subject is briefly discussed here for the sake of completeness. Development of the remaining major hydro sites is likely to continue along the traditional lines; that is implementation of the schemes by the CEB with soft loan funds. However, because of the recent emphasis on private power, some attempts have been made to attract private developers to invest in this field. The chances of success of these attempts are not very bright as reasons to discourage serious private developers are many. The more important ones are: most schemes are multi-purpose, environmental problems are significant, initial development costs are high, energy availability is subject to rainfall, and construction risk assessment of large hydro projects is well nigh impossible.

Environmental issues connected with hydro-power schemes have been hotly debated in recent times. Two of the significant issues are: resettlement of displaced families and aesthetic considerations associated with waterfalls. The resettlement issue can be resolved by obtaining voluntary consent and ensuring that the living standards of resettled families do not suffer. Valuation of beauty is a subjective matter. However, any loss of beauty must be weighed against the benign nature of hydro power — no green house gases, no acid rain,— and the fact that it is the only proven, commercially viable indigenous resource for Sri Lanka.

5.2 Small-hydro

All the existing mini-hydro schemes have been developed by the public sector—CEB or another public sector organization. However, the CEB, in the foreseeable future will have to concentrate its energies on developing the thermal and major-hydro power stations to cater for the rapidly increasing demand for electricity. The task of developing the small hydro schemes may therefore fall on the private sector. However, to attract private sector, a policy framework that is conducive to private participation should be in place.

One of the most important pre-conditions for private power development is the existence of a regulatory and legal framework that encourages participation of the private sector. Existing legal and regulatory framework for the power sector is provided by the Electricity Act, Chapter 205 of the Legislative Enactments of Sri Lanka. The original Act, dated 1950, and later amendments assume that generation and transmission will be carried out by a single vertically integrated utility. It further assumes that distribution will be carried out by licensees under the Act, though licensees are not precluded from generating. As the present framework is based on these assumptions it does not provide the necessary incentives for the private sector to participate in power development. A new legal and regulatory framework that encourages private participation should therefore be developed.

Availability of projects whose economic and environmental feasibility is established will be necessary to attract serious private sector developers. Cost of conducting prefeasibility and feasibility studies is quite high. Private investors are not likely to bear this cost without any certainty that the project will get approved. This is borne out by the recent attempts to get the private sector to develop a few hydro sites. After almost four years, negotiations have not been completed. The CEB should therefore carry out a Master Plan study of the river basins in the country. If a country-wide study is too costly, studies could be carried out on a basis of river basin by basin. The projects that would fit into a least cost plan should be opened for private development.

Build-Own-Operate(BOO) and Build-Operate-Transfer(BOT) schemes provide mechanisms by which private developers can participate in developing the small hydros. Large BOO/BOT schemes involve extremely lengthy and complex negotiations, which also are very costly. It is not feasible to develop the small schemes by negotiation in a similar manner because it would be too time consuming and costly. Much time is spent during these negotiations on the power purchase agreement, the purchase tariff, and the grid interconnection requirements. This can be overcome by developing a standardized non-negotiable power purchase agreement, a project independent standardized tariff and a grid interconnection code.

Very small hydro schemes up to about 50 kW — usually only a few kilowatts in capacity — are not to be grid-connected. They are primarily intended for supplying the basic electricity needs of remote villages to which the cost of extending the grid is prohibitive. Their development would depend on the intervention of a non-governmental organization or provincial authorities. The schemes are usually administered by a local village society. Though these schemes may not generate a lot of power they have a significant social value. In remote rural areas, availability of electricity, even only for lighting and TV, can be quite beneficial and is highly valued by the population. It is seen as a sign of development and could be a catalyst for further development of these areas.

5.3 Wind

Wind resource data are presently available only for the South-Eastern coastal belt from Hambantota to Kirinda. There is therefore a need to expand these studies to cover the whole country.

Average wind speeds, estimated from available studies, are rather moderate, at under 6 m/s. On the basis of present equipment costs, wind power is commercially viable at wind speeds of around 8 m/s. The indication is that wind power in Sri Lanka, at present, can only be marginally commercially viable. However, the equipment costs in the world market have been decreasing since the early eighties and this trend is expected to continue, though not at the same rate. Taking cognizance of the equipment cost forecasts, wind energy should be very competitive in the next decade.

The available wind speed data have been collected at heights ranging from 3 to 20 meters. However, the parameter relevant to energy generation is the wind speed at the wind generator hub height which is about 35 meters. Further, wind measurements are carried out at locations convenient for long term measurements and not at the actual wind farm sites. Therefore, there is a need to estimate the wind speed at the wind-farm site from the available data. This could lead to an appreciable error in the estimated output of the plant.

Grid-connection of wind generators pauses certain technical problems because the output of a wind generator varies according to the wind speed. Detailed distribution and transmission system studies are required before connecting these plants to the grid. Most wind farms will be situated in rural areas where the grid system is weak. Consequently, the wind generation that can be connected will be low. For example, the maximum wind power that can be connected at Hambantota will only be 4 MW.

To study the grid integration and output estimation issues under actual operating conditions and also to gain operational experience a pilot wind farm with adequate instrumentation should be constructed. It could also serve as a demostration plant.

A few private developers have shown great enthusiasm in wind power development. To attract credible developers, it will be necessary for the CEB to identify suitable sites and conduct feasibility studies. It is likely that most schemes will be fairly small because of site restrictions. Standardized procedures discussed under small-hydros can be used for private wind farms.

5.4 Solar

Solar home systems can provide the basic electricity needs for lighting and small appliances in a cost effective manner. The principal purchasers of SHSs are likely to be rural households currently using kerosene lamps for lighting, and automotive batteries for operating television sets. Recent estimates indicate that there are approximately 300,000 to 350,000 such users in the country. It has been shown that SHS is the least cost option for satisfying their basic electricity needs at current SHS costs. Experience to date suggests that the following issues need to be addressed satisfactorily to enhance the dissemination of SHSs: High capital and maintenance cost, inadequate flow of funds, inadequate service organizations, lack of awareness, inadequate solar electrification planning.

Utilities which are designed to handle large centralized power systems are not suitable for implementing solar electrification programmes because of the decentralized nature of operations. The implementation of solar programmes should therefore be left to the private sector and non-governmental organizations (NGOs). However, the utilities can assist the effort by incorporating SHS as an option in their rural electrification planning, educating the users, and providing technical support and training. The Government can assist in the reduction of first cost by: granting credit for the non-polluting nature, making low costs funds available to the sector, and rationalizing the import duties and taxes. It can also encourage the private sector to implement installment loan schemes for the purchase of SHSs.

6.0 The Agenda

6.1 Legal and Regulatory Framework

A consultant has been appointed to conduct a study to examine legal and regulatory framework and policy incentives required to promote private sector development. The assignment is in two phases; Phase I focuses on the institutional structure of the power sector and the regulatory regime and phase II focuses on the definition and implementation of the sector's organizational structure and the regulatory framework identified in Phase I. The guiding principle for the development of the regulatory framework is to set up transparent regulatory processes that are clearly independent of power suppliers and that avoid government interference in day-to-day power company operations. The regulatory framework should establish a sound basis for open discussion of power sector economic, environmental and service policies. Phase I is now nearing completion. The enabling legislation is expected to be presented before the parliament before the end of 1997.

6.2 Renewable Energy Development Fund

Recognizing that the high cost of capital is a major obstacle to the development of renewable energy, a proposal had been made to the World Bank to assist in the creation of a fund to provide low interest, long term loans for renewable energy development. The proposal has been accepted and forms one component of the proposed Energy Services Delivery (ESD) project. The project is estimated to cost about US$ 55 million. About US$ 30 million will be provided by the International Development Association (IDA) of the World Bank on concessionary terms, and about US $9 million will be by the Global Environmental Facility (GEF) as a grant. About US$ 30 million of the project funds will be used to establish the Fund. Renewable energy development projects up to 5 MW in capacity will be eligible for obtaining loans denominated in Sri Lanka Rupees from this Fund. The GEF grant component will be passed on to developers of projects eligible for environmental credit as a grant. Projects that avoid green house gas emissions by the use of renewable technologies will be eligible for environmental credit. The Fund will be administered by a local development bank, and the funds will be channeled to the developers through the participating banks. The Fund is expected to be in place by the middle of 1997.

6.3 Standard Power Purchase Agreement (SPPA)

The need for a SPPA was discussed earlier. Its advantages are: minimizes risk for all parties, fair and equitable, transparent, minimizes transaction costs to all parties, especially to small power producers who lack legal, technical and negotiating resources, streamlines and speeds up the process of resource acquisition as the contract is pre-approved. Preparation of a standard contract commenced last year with the assistance of a consultant engaged by the World Bank. The draft SPPA has reached the final stage. All terms and conditions of the SPPA are set and standardized and do not involve, negotiation. Only three schedules are required to be filled. One schedule describes the facility, another the interconnection facilities, and the third is the standard purchase tariff schedule. The standard tariff and the grid interconnection code are integral parts of the contract. It is based on the concept of a "must run facility". What it means is that there is no obligation on the part of the producer to run his plant.

However, CEB will purchase whenever he is able to produce and sell. This should be a great incentive to small power producers as the producer is certain of being able to sell all his output.

6.4 A Standardized Tariff

To have a standard PPA for all renewable projects, it is necessary to have a standard tariff that is independent of the technology. Further, the process of determining the tariff must be transparent to get investor confidence. A tariff based on system avoided costs would satisfy these conditions. The concept is simple: whenever, the utility purchases a unit of electricity it avoids generating it. As a rational operator of a power system, the utility would avoid generating one unit from the generator with highest operating cost — fuel and variable operation and maintenance costs. In other words, he will avoid generating a marginal unit. For example, when gas turbines are running the marginal unit will be from the gas turbines. This avoided cost of the marginal unit is the maximum price the utility can pay. Though the concept is simple the computations involved in its determination are complex. Because at different times of the day and at different times of the year different machines will be at the margin. CEB engaged the services of a consultant, with financial assistance from the World Bank, to develop a methodology for the calculation of the tariff. A tariff based on avoided costs is clearly independent of the technology of generation, as it is based on system avoided costs only, and is just and equitable. Standard purchase tariff is now being determined in accordance with this methodology. The tariff is scheduled to be announced in December and will be effective from January 1997.

6.5 A Grid Connection Code

When a small generator is synchronized to the grid it becomes part of the grid system. To ensure safe operation of the system, comprising both the utility and the operator's systems, a grid interconnection standard is necessary. An interconnection code is under development now. Until it is completed, CEB will use the U.K. Engineering Recommendation G 59/1, 'Recommendations for the Connection of Embedded Generating Plant to the Regional Electricity Companies' Distribution System' modified to suit the local electricity system. The essential features of the grid code are summarised below. Compliance with statutory requirements—that is with the Electricity Act and the Electricity Regulations. Neutral Earthing to comply with the Act and to ensure that the system is properly earthed at all times to ensure safety. Written agreement of the CEB required regarding the means of synchronization and means of disconnection. It is necessary for the power producer to make authorized staff available at all times to carry out CEB system control engineers instructions, and therefore, and ensure availability of an efficient means of communication. As a minimum protection is required to isolate the machine in case of under voltage or over voltage, under frequency or over frequency and loss of mains, it is the responsibility of the producer to carry out the testing and commissioning in the presence of a CEB engineer. The Grid Connection code is expected to be completed before the end of 1997.

6.6 Small-hydro Masterplan

As a pilot project CEB will investigate the hydro power potential of a complete river system — Ging ganga has been selected — with the assistance of foreign consultants, funded under a UNDP/GEF project for Renewable energy capacity building. The project is expected to provide a detailed assessment of the mini-hydro potential of the river system and develop a methodology for the evaluation of small hydro for application in other assessments. The project is seen as a prelude to the development of a complete masterplan of mini- and micro-hydro potential of the country.

6.7 Pilot Wind Farm

A pilot wind farm of 3 MW capacity will be established in the Hambantota area, near Weerawila to gain operational experience and also as a demonstration plant. The feasibility study has been completed and the tender books are under preparation. The plant will be funded under the ESD project, and is planned to be commissioned before the end of 1997. This will be the first grid-connected wind farm in Sri Lanka.

6.8 Wind Resource Assessment Studies

Under the UNDP/GEF project mentioned earlier a wind resource assessment of the West coast will be carried out. Under this project wind monitoring stations will be set up along the West coast and other locations in the country and hourly wind data logged. The activity is expected to lead to the identification of possible locations for wind farm development.

6.9 Off-grid Applications

SHSs projects qualify for loans from the Renewable Energy Development Fund. They will also qualify for the GEF grant because of the non-polluting nature of the technology. About 5000 SHSs are expected to be funded under this scheme. The Fund will also extend the same facilities for microhydro projects to provide electricity to about 50 remote villages.

6.10 Institutional Capacity Enhancing

Under the two projects mentioned above there will be assistance to develop the capacity of the institutions involved with renewable energy projects. These institutions include the CEB, Ministry of Science and Technology, NERD Centre, Bureau of Standards, Energy Conservation Fund, Sri Lanka Energy Managers Association and a number of other NGOs.

7.0 Conclusion

Renewable energy technologies that have been developed to a stage of commercial viability are hydro and wind for grid connection and solar for off-grid applications. Development of renewables is important to Sri Lanka because it has no fossil fuel resources. Most of the hydro potential of the major schemes has been exploited and what remains to be done is to develop the potential of the smaller schemes. The private sector appears to be better equipped for this task than the public sector. However, an environment conducive for private power development has to be created for this purpose. The regulatory framework proposed and the Standard Power Purchase Agreement together with the Standard Tariff and the grid connection code should accomplish this task.

Commercial viability of wind farms is yet to be established because of the modest wind speeds. The proposed wind farm should provide operational data for this purpose. It is hoped that the agenda described above, when implemented would dawn a new era of renewable energy development in the country.

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