




# *E-Scene*

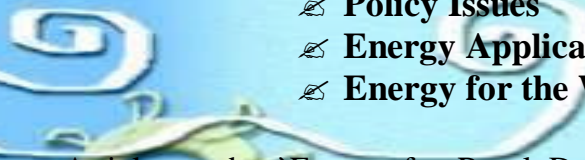
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**This issue of ESCENE presents some of the Energy Forum's involvements in the last few years under the themes of**

-  **Energy for Rural Development**
-  **Policy Issues**
-  **Energy Applications**
-  **Energy for the War-affected**



Articles under 'Energy for Rural Development' discuss the role played by renewable energy in rural development, which is actually an extension of its conventional role of providing domestic electricity. However, it is argued that access to electricity does not automatically lead to rural development, but a special effort has to be made to link both aspects.

Articles on 'Policy Issues' focus mainly on the need for off-grid electrification and the potential of renewable energy sources to fulfill that need, as well as the importance of addressing renewable options in current power sector reforms. It is argued that there is a need for a national energy policy inclusive of the major concerns of stakeholders in the energy sector, if the current crisis in the energy sector is to be solved.

The Energy Forum's involvement in providing renewable energy systems, installing plants and in improving rural energy technologies in the recent past is presented in the section, 'Energy Applications'.

The article under 'Energy for the War-affected' gives a brief idea of the role played by the Energy Forum in the war-affected Batticaloa district.

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## **The Energy Forum**

The Energy Forum of Sri Lanka is an NGO working to promote renewable and distributed energy options to alleviate poverty, to address energy capacity deficiencies, and to protect the environment. As a network of individuals and organizations from government institutions, Provincial Councils, the private sector, NGOs, utilities, universities, and research institutions, the Energy Forum serves as a network hub for non-partisan energy information and research. The Energy Forum specializes in grassroots community awareness-raising and has created close working partnerships with community leaders, business leaders, provincial council and divisional officials, policy makers, journalists, school children and teachers, and other NGOs and community-based organizations.

The Energy Forum plays an active role as an organization specializing in the field of energy and has made significant contributions to the promotion of the renewable energy sector. This includes: the provision of renewable energy services to Sri Lankan off-grid communities; creating awareness of renewable energy at the community level; introducing rural economic development activities utilizing off-grid energy technologies; research and development initiatives to assess cross-sectoral applications of renewable energy; acting as a partner for local and global renewable energy initiatives; and promotion of fair and sustainable energy policy.

# ENERGY FOR RURAL DEVELOPMENT



A study conducted by the Energy Forum in Monaragala and Batticaloa districts in 2002 reveals that there is no direct relationship between energy supply and poverty reduction. To achieve poverty reduction, a special effort has to be made to integrate energy and economic development initiatives. The Center for Poverty Analysis (CEPA) provided financial assistance for this study.

## 1.1 Energy Supply and Poverty Reduction: Are They Correlated? A Study

This study seeks to discover the potential relationship between energy development and poverty alleviation. It focuses on the perspectives and requirements of the rural poor. In order to achieve the intended goal, the Energy Forum conducted a short survey among 440 households in two districts: Moneragala and Batticaloa.

The study examined 3 types of households:

- 1) rural grid-connected households,
- 2) off-grid households using locally generated electricity (i.e., solar-home systems, village hydro), and
- 3) off-grid households without electricity using kerosene and other fuel sources.

It compared income levels among the 3 categories in order to ascertain the role of energy/electrification in alleviating poverty in rural areas.

Community leaders of the 2 districts analyzed the important findings in participatory workshops. The following 2 research questions played a guiding role in the analysis: what is the relationship between electrification and income generation, and how can electrification/energy be used to alleviate poverty?

## **Major Findings**

- ? Electricity is a principal requirement at the village level. Other main requirements at the village level are water, a stable market for agricultural products, and industries to create more employment.
- ? The main requirements at the household level are house construction/repair, electricity, education and employment. When it comes to electricity, having electricity for domestic lighting during 7.00 pm - 10.00 pm and for viewing a TV is a basic need.
- ? Richer people with a decentralized energy source are not satisfied with the available energy supply.
- ? On-grid higher income groups consume more electricity, than off-grid higher income groups.
- ? Even though the survey showed that electricity was a priority, several community leaders felt that malnutrition was a more important problem.
- ? The income generation opportunities in the electrified villages are higher than in un-electrified villages, and include opportunities in welding, carpentry, vehicle repair, rice milling and cereal grinding.
- ? People do not have the financial capital to invest in industrial activities even if electricity is available. It is also very difficult to get bank loans. Technical training is unavailable which influences income-generating potential regardless of whether a village is electrified or not.
- ? Value-addition for agricultural products is a potential economic growth sector.

## **Conclusions of the Study**

- ? Electricity is a priority of the off-grid community. Hence, electricity can be considered a basic need. There is no clear direct relationship between energy supply and income generation. Even if there is no direct connection, people believe that having access to electricity is a basic need. This is further proven based on the fact that politicians always promise to supply electricity. Electricity is a development goal unto itself. People living off-grid have a very high regard for the ways electricity makes life easier. Hence there should be an integrated program for economic development at the community level using electrification as a springboard. Those who want to generate income should be encouraged and protected. If the grid is extended, there should be an integrated program to ensure that income-generation activities take place alongside a monitoring and evaluation program.
- ? Moreover, based on experiences in Moneragala, it has been pointed out that when certain villages get electricity, they develop the potential for becoming towns. Information on villages that carry the potential of becoming towns with the acquisition of electricity should be fed to the government planning process.
- ? Batticaloa District has a special issue: fuel-wood scarcity. The Fuel-wood problem in Batticaloa needs to be addressed through introduction of new technologies.

## 1.2 Going beyond House Lighting: Cross-sectoral applications of off-grid Renewable Energy

**RERED, The Renewable Energy for Rural Economic Development Project, focuses on promoting rural development through electricity access for community applications in education, health and water supply, as well as on the potential for energy provision to promote rural income generation. Energy Forum acts as the consultancy firm providing primary support to the Northeastern, Southern and Uva Provincial Councils and involved ministries in order to implement these cross-sectoral activities.**

Building on an earlier successful experience in developing a renewable energy market in Sri Lanka, the Government has embarked on a Renewable Energy for Rural Economic Development (RERED) Project with support from the World Bank and Global Environment Facility. The primary contact point for the RERED Project is the Administrative Unit (AU) at the DFCC Bank.

The RERED Project focuses on promoting rural development through electricity access for community applications such as education, health and water supply as well as on the potential for energy provision to promote rural income generation. To support this, the Project operates jointly with relevant Government Ministries and Provincial Councils. These cross-sectoral linkages ensure that, even for households unable to directly access electricity supply, they can nevertheless benefit from health, education and water services that are improved or expanded through electricity supply. Furthermore, there is great scope for applying energy efficiency and conservation measures in the larger institutions, thereby reducing otherwise large energy expenses.

### **Role of the Energy Forum**

The AU has engaged the Energy Forum to provide primary support to the Northeastern, Southern and the Uva Provincial Councils (PCs) and involved ministries to implement these cross-sectoral activities. The Energy Forum reviews and finalizes the implementation strategy prepared by a consultant in consultation with the Northeastern Provincial Council (NEPC), and facilitates its rapid implementation. A key goal of the Energy Forum's work is to create a sense of ownership within the Provincial Government for these cross-sectoral activities. This requires a strong emphasis on capacity building as well as on-the-job and formal training sessions.

### 1.3 Village Hydro Projects to Promote Rural Enterprises

**The Federation of Electricity Consumer Societies (FECS) takes steps to incorporate economic development activities in stand-alone village hydro schemes and to develop appropriate implementation mechanisms. FECS implements the project with 20 selected Consumer Societies and in so doing obtains the services of the Energy Forum and the Provincial Councils. This project is funded by the REREDP.**

There are over 120 stand-alone village hydro schemes in operation in Sri Lanka. Installed capacity of the hydro plants in these schemes is generally designed to meet the domestic lighting load (and TV & radio/cassette sets) that occurs during evening hours. Thus, the capacity of the hydro plant remains underutilized during daytime.

There is evidence that this surplus energy is being used for income-generating activities in a very limited number of schemes. Electricity Consumers Societies (ECS) in such schemes have adapted different types of policies and tariff systems for those who are engaged in income-generating work as well as accommodated new subscribers. It appears that existing experience and institutional mechanisms could be used in the design and implementation of economic development activities.

#### **Rationale**

Integration of village hydro schemes into economic development requires a systematic approach, which goes beyond conducting brainstorming sessions. It is essential to link other development-oriented activities of local agencies such as Samurdi, IRDP, Provincial Councils and NGOs with the economic development projects. By taking objectives such as establishing the viability of incorporating economic development activities in village hydro schemes, and developing appropriate implementation mechanisms, FECS is implementing a project funded by REREDP with the selected 20 ECSs. The work-plan of the project includes the following items: Investigate the standards of the Village Hydro Scheme and assess access to the available energy; Negotiate with relevant authorities to improve the technical standard of the Village Hydro Schemes; Develop business plans for Economic Development Projects; Correspond with relevant lending agencies and financial mechanisms for capital investment; Link with vocational training courses to build the capacity required for enterprise development; Develop market mechanisms for the products; and establish Economic Development Projects. Where appropriate, projects should maintain collaboration with Samurdhi and Provincial Councils.



### 2.1 A Survey of Off-Grid Dendro Potential

**A survey conducted on off-grid dendro potential identifies that almost all the dry-zone off-grid villages in Sri Lanka have enough sparsely used croplands that can be effectively used to establish energy plantations for supplying fuel-wood to generate electricity for the consumption of off-grid households. In the Monaragala district alone, dendro can provide 250W of electricity (per house) for 1919 off-grid households in 13 GN divisions. This World Bank-funded survey was conducted by Energy Forum on behalf of the Ministry of Natural Resources and Environment of Sri Lanka.**

The objective of the survey was to evaluate off-grid dendro power potential. To this end, EF gathered information from three main sources: CEB information on off-grid GN divisions; Land Use Department information on land use in those divisions; and ITDG information regarding energy usage at the district-level. Because of research time constraints, this study was limited by the incomplete information available from CEB. Thus, this research must be viewed in light of the limited data on off-grid areas available; it can best be viewed as a sample survey rather than a comprehensive analysis. For this research, districts in the dry zone were selected, and no information was available in the north and east. Hence, the database is limited to seven districts.

The detailed survey concentrated on the Monaragala District because they have the lowest electrification rate, low population density, high land availability, a commitment by the Provincial Council to support renewable energy sources, and familiarity with plantations and out-growing systems. In Monaragala, we were able to collect data on villages beyond the CEB's 6km threshold and we also collected data on off-grid villages 3 - 6km from the existing grid. The survey used the flat rate of 250W per household for off-grid electricity needs.

#### Home Gardens

For this analysis, EF used scrubland, grassland, and chena. According to local community opinion, they can gather enough raw materials from the home garden itself. They base this assessment on the fact that they already use plantation systems for purposes other than energy. Assessments of dendro potential made in this study do not include home garden-growing potential for fuel wood. In addition to adding significant acreage, home garden plantations would require significantly less effort to gather wood since they are close to home.

## **Community Impact**

In the rural areas assessed for dendro potential in the current study, community members are supportive of fuel wood plantations. First, like most off-grid households, they would like to enjoy the benefits of grid electricity in their homes. The identified electricity needs are strongly concentrated on lighting and TV. Secondly, in addition to being higher quality energy (than kerosene burning and battery electricity), dendro power promises to be a cheaper overall source of energy. Third, plantation farming is nothing new for community members from rural dry zone areas. They are familiar with and use wood species identified as appropriate for fuel wood, using these species for fencing and support of agricultural crops. They also use the leaves as fertilizer and goat feed. Local community members were surprised that there is potential revenue in these native plant species because they are so plentiful. In fact, these species are often considered to be a nuisance because they grow so quickly and spread so readily.

## **Economic Incentives**

At least some of the local community members can earn income out of dendro power by supplying significant amounts of fuel wood to conversion plants. Nearly everyone with whom the project was discussed was willing to plant the fuel wood if they can sell it. With proper spacing, the fuel wood plants will not disturb the seasonal crops (krrakan and corn are usually grown). Thus, the income from fuel wood would be above and beyond the normal sources of income for farmers. At Rs. 1000 per ton, fuel wood brings a profit of Rs. 20,000 per hectare in addition to Rs. 22,000 (in general) earned by farmers from growing corn and kurakkan.

## **Managing the Plant**

There are several possible management arrangements. The study discussed 3 types of arrangements with the community

- ? A privately owned power plant and plantation
- ? A cooperative type power plant, with fuel wood purchased from identified suppliers
- ? An exchange system, where community members exchange fuel wood for electricity

The community members preferred the second option (where suppliers are specified in advance), because it was most likely to ensure the continuity of supply. In the third case, if one person fails to supply, then the whole system might be temporarily compromised. Community members were not interested in a purely private organization, since they already have cooperative savings and credit societies that work well which they are familiar with.

## 2.2 The Energy Crisis in Sri Lanka: Can WASP 3+ Do Something About It?

**The Energy Forum identifies the current crisis in the energy sector as a question of major concern for all stakeholders engaged in energy production and use, especially for those not adequately represented in the energy planning process. As there is no adequate opportunity to present their views some parties act against the proper implementation of an energy plan. Believing that least-cost energy production and protecting environmental and community social systems is in the country's best interest, and should therefore be integrated in energy planning, this study conducted by the Energy Forum explores available mechanisms that are practiced worldwide to achieve various aspects of this objective.**

This study was initiated as a result of the recommendation made at a meeting of energy generation and use-stakeholder representatives. The ENERGY FORUM organized this meeting to discuss the concept of an 'Energy Development Index', which is introduced as a tool to influence energy policy of a country by addressing concerns related to energy generation and use. However, the meeting recommended, as an intermediary step, to use WASP 3+ software to see how environmental concerns can be incorporated into the Long Term Electricity Generation Expansion Plan (LTEGEP) in Sri Lanka.

This two-month study was guided by two objectives:

- (a) To study the principles used in addressing environmental concerns by the WASP 3+ package for LTEGEP.
- (b) To conduct an information-gathering survey on approaches and methods introduced and practiced worldwide to incorporate environmental concerns in energy planning.

### **What is WASP 3+ Capable of?**

WASP 3+ is the software currently being used by the Ceylon Electricity Board for electricity generation expansion planning. WASP3+, as a part of ELECTRIC module of ENPEP (Energy and Power Evaluation Programme), is not a tool to quantify environmental impacts of LTEGP or cost them. WASP 3+ in combination with IMPACTS module of ENPEP provides the following services:

- (i) After preparing the generation expansion plan based on the least internal costs, it selects the cheapest abatement technology (out of its database) that could meet respective ambient environment standards and hence estimates system-wide costs of complying with air regulations.
- (ii) Calculates both uncontrolled and controlled emissions of the generation expansion plan based on fuel consumption projected by WASP and standard emission factors available in one of the databases.

There are, however, several other software tools available (in addition to WASP 3+) to fulfill different tasks in studying environmental impacts of electricity production, as well as energy production in general. There are a number of software tools that are designed specially for developing countries where required databases are not well developed.

### **Environmental Concerns: How Serious are they?**

Costing environmental, health and other impacts of electricity generation – known as costing externalities- provides one way to assess the seriousness of problems associated with electricity generation. Some of the external cost studies done for fuel cycles in the Electricity Sector highlight the scale of the issue. De Lavergne calculates the external costs of coal, gas and nuclear fuels to be 81.1%, 52.0% and 2.3% of the total cost, respectively. A Study by Diakoulaki, *et al* shows, as a mean scenario, the externality costs as a percentage of total traditional costs for seven fuel types as follows: Lignite (80.4); Fuel Oil (46.1); Natural Gas (30.2); Hydro (9.8); Wind (6.3); Biomass (4.7); and Photovoltaic Cells (0.61).

When analyzing costs of various full fuel cycles, it is important to question the relevance of these cost values for Sri Lanka, especially if we are to use these cost values as a supportive guideline in policy formulation. As a country with no fossil fuel resources, it is useful to analyze the external costs at the production stage as well as for down-stream stages. The ExternE study shows that the environmental and health impacts of the production stages of fossil fuel cycles to be the most significant compared to the impacts of other stages. Percentages of external costs at the production stage in relation to total external costs for fossil fuels are as follows: Coal: 83.5% - 96.2%, Oil: 86.6% - 94.3%, Gas: 79.7% - 99.9% (range of values represent country average values for each fuel type).

### **Approaches to Incorporate Stakeholder Concerns in Energy Planning**

There are at least 3 different approaches within which various proposals and practices to incorporate stakeholder concerns could be located. All 3 approaches provide different ways to include national development, environmental and other social concerns into the current major concern of energy-planning with the least financial cost for the producers.

- ? Approach of direct control of burdens (e.g. emissions) of energy industry,
- ? Approach of addressing concerns through pricing mechanisms, and
- ? Multi criteria analysis.

#### **Direct control of burdens**

This is at the moment the most widely practiced way to minimize environmental damages of industry, which includes the industry of energy generation. Here it is made compulsory for the energy generation designs to meet set environmental and health regulations and standards expressed as burden-limits. The regulations and standards are collective decisions arrived at, according to perceived seriousness of the environmental impact under consideration.

## Addressing concerns through pricing mechanisms

There are at least four main ways to incorporate various stakeholder concerns using pricing mechanisms.

**(a) Internalization of externalities:** This is the most basic way of incorporating environmental, health and other social impacts into energy generation planning. Here the external costs of these impacts of energy generation are calculated and included into conventional financial costing to figure out the unit cost of electricity. External costing of energy generation is a useful exercise even if internalization is not done. External cost values of various fuel types and technologies could provide useful insights to national and regional energy policy makers, decision-makers in the energy sector and technology designers.

**(b) Pollution taxing:** This is less complicated (than external costing) and hence, a widely used approach to incorporate the environmental damages of electricity generation into pricing mechanisms. Taxes discourage the environmentally damaging practices and raise revenue to repair damages. Cost-covering charges, incentive taxes and revenue-raising taxes are sub categories of taxes coming under pollution taxes.

**(c) Subsidizing sustainable energy alternatives:** In some contexts where pollution taxing presents difficulties, subsidizing sustainable energy alternatives is considered the better option to incorporate environment and social impacts of electricity generation. Proponents of subsidizing alternatives argue that coal, fuel oil and natural gas are currently subsidized by conventional benefit-cost analysis by not taking their environmental impacts into consideration. `Renewable Obligation Schemes` practiced in Europe in general and in UK in particular provide a special mechanism that could be identified under this approach.

**(d) Emission trading:** Within the context of industrialized nations, industries that pollute the environment are handed out permits and if a polluter manages to reduce pollution below the amount allowed by the permit, then a portion of her/his emission right is unused and can be sold in the open market to another polluter who is unable to meet emission standards.

## Multi-Criteria Analysis

Multi-criteria analysis allows achieving multiple objectives in electricity planning, instead of having least financial costing as the only objective. Multi-criteria analysis identifies broader overall objectives at a primary level (e.g. financial cost, sustainability, etc.) and then at a secondary level, a break down of operational objectives (e.g. dependence on indigenous sources for electricity generation).

**Energy Development Index**, a concept proposed by the Energy Forum, comes under this category of approach and acts as a useful tool in electricity planning and in negotiating between independent stakeholder interests. By making transparent the value judgments behind a certain energy expansion plan, Energy Development Index rationalizes decision making in energy planning.

## 2.3 Dendro Expands: Not Just an Energy Option Any More



### In the year 2010 dendro could:

- ? **Generate 5752.5 GWH of electrical energy (50% of the total Sri Lanka energy requirement)**
- ? **Generate an additional annual income of Rs. 90,000 each, for 60,000 farming families**
- ? **Save Rs. 46 Billion of foreign currency**
- ? **Grow an additional forest/tree cover of 176,630 Ha for Sri Lanka**

**Says a press release of the Bio Energy Association of Sri Lanka**

If the country decides to take the route the Ceylon Electricity Board recommends to meet our electrical power needs, by about the year 2010 the country would exhaust all its foreign exchange earnings from traditional exports of Tea, Rubber, and Coconut i.e., Rs. 90,000 Million, to cover the foreign exchange payments for power generated by imported fossil fuel. Furthermore, domestic dendro-energy production for meeting electricity requirements has the supplemental benefits of providing rural economic growth, employment generation, foreign exchange savings, a potential carbon sink, power to inaccessible areas, opportunities for large-scale livestock and link-industries, enriching degraded soils, preventing soil erosion, increasing forest / tree cover, and adding power to the national grid.

### **GINISIRIYA: The Main Energy Source**

The country has an abundance of Sustainably Grown Fuel-wood - (SGF) varieties that can be productively converted into useful forms of energy without depleting the sources of supply whilst ensuring environmental health. The main variety identified for this purpose is Ginisiriya - (Gliricidia Sepium) also commonly known as Wetahiriya, Wetamara, Ladappa, Nanchi, Sevana, and Kola Pohora.

Ginisiriya is widely available, particularly in the rural countryside as well as in Tea and Coconut Plantations. There are many other varieties of trees that fall into a similar category. Some of them are Kaha Kona (Cassia siamea) Ipil Ipil (Leuceana Leucocephala) and Kalapu Andara - Mestique (Prosopis). Income for a farmer per annum from a one acre plot of Ginisiriya will be: BASE CASE- Rs. 16,065 at Rs 1.50 per Kg ,and BEST CASE -Rs. 31,500 at Rs 1.50 per Kg.

### **Current Situation**

- ? The Ministry of Science and Technology has successfully completed a programme to demonstrate the feasibility of Sustainable Short Rotation Coppice plantations.
- ? Haycarb Limited has ventured into a DENDRO Thermal application at their Activated Carbon project at Badalgama and the Coir Fibre Industry at Madampe. In both locations Haycarb have installed DENDRO Gasifiers fuelled by SGF Biomass - Ginisiriya giving them more than 50% reduction in fossil fuel use.
- ? The Lanka Transformers Limited successfully tested a 35kW Dendro electricity-generation plant at Sapugaskanda and it was re-installed by the Energy Forum at the Wadagahakilua off-grid village in Moneragala District in December to provide electricity to 100 households.
- ? A 3kW dendro power plant for electricity generation is established at a Coconut estate in Madampe.
- ? Lanka Transformers Limited along with Ceylon Tobacco Company Limited has commenced construction of a 1 MW Dendro power plant to provide electricity to the National Grid at Walapane.

### **Recommendations to the Government**

- ? The role of Renewable Energy should be built into the governments National Energy Policy. A policy for Bio Energy should be embedded in the Renewable Energy policy.
- ? Establish transparent, equitable and reasonable tariff policies for the purchase of Bio Energy to the national grid recognizing the availability of such sources of power independent of the weather and their contribution to power generation capacity.
- ? Establish a series of pilot programs for establishing the viability of SGF wood as a primary energy input for heat and electricity generation.
- ? Offer reasonable subsidies for developers of systems to service these areas to minimize their investment risks.
- ? Establish a revolving fund of Rs 100 Million for the growing of SGF plantations at interest rates comparable with donor funds
- ? Establish a minimum of four off-grid community power projects for village electrification.
- ? Establish combined cycle plants in the Tea, and Coconut Plantation Industry
- ? Develop mechanisms to establish SGF in 176,630 Ha of land and to provide 5752.5 GWH of electricity to accommodate 50% of the annual projected electricity demand by the year 2010.

## 2.4 A Missing Element: Rural Electrification in Power Sector Reforms

The Energy Forum, ITDG and Citizen's Trust had a number of consultations with the Public Interest Program Unit (PIPU) of the Ministry of Economic Reforms and its consultants to incorporate an off-grid component in the restructuring process. While recognizing the reforms of the electricity sector as a timely exercise, the involved organizations raise concerns about the impact of the reforms on the poorer communities in Sri Lanka, particularly as the reforms only focus on the main grid electricity system. The PIPU has responded positively towards these concerns and made certain amendments to the draft proposal to incorporate the off-grid energy sector in the regulatory structure.

Over recent years in Sri Lanka, considerable progress has been made towards the establishment of an environment and a market for decentralized energy supply (micro hydro, solar, wind and bio-fuels) to supply the needs of poor and remote communities. There is concern that the electricity sector reforms and the current policies will have negative impacts on the progress of these decentralized, community based schemes, unless mechanisms are set in place to address them.

### Concerns

- ? There appears to be no National Energy Policy for Sri Lanka. There are instead two documents setting out *power sector policy guidelines* and a *policy for rural electrification*. These two documents in any event pre-date the establishment of two key power sector reform laws, namely the *Electricity Reforms Act* and the *Public Utilities Commission Act* and hence the *policy for rural electrification* is not up-to-date. To make things worse the *power sector policy guidelines* do not refer to rural electrification.
- ? Various government departments and donors do plan certain initiatives in energy, rural energy, and renewable energy. There seems poor or no co-ordination of these initiatives with the policy guidelines and the interests of the state.
- ? According to the policy, Sri Lanka can only achieve 80% electrification through the national grid. This leaves 20% of consumers who will not have access to the grid and can only be supplied through off-grid systems. The power sector reforms do not clearly specify how they intend to promote rural electrification for off-grid consumers.
- ? There are a number of off-grid systems that currently provide electricity. We believe it is important to clarify and ensure the status of these off-grid systems in the new reformed power sector. Currently the off-grid community-owned electricity generation systems do not have legal status. However, the proposed reforms prevent a single license holder from both generating & distributing electricity. Will the off-grid systems owned by rural communities be able to apply for the exemptions



mentioned in the *policy guidelines*? Will these exempted license-holders be covered by the regulator? The proposal to give one distribution company exclusive distribution rights over a geographical area will have serious implications for such community-owned systems.

- ? Electricity is a devolved subject under the 13<sup>th</sup> Amendment to the Constitution. Currently, the Provincial Council (PC) and local authorities play an important role in rural electrification. There are significant numbers of off-grid systems that are promoted by Provincial Councils, especially in the provinces of Uva, Sabaragamuwa and Southern. The policy guidelines do not refer to this link.
- ? There is an unethical situation created by mini-hydro projects using community owned resources without giving back any benefits to the community (income or electricity connections). Can part of the profits generated from these mini-hydro installations be invested in economic and social development in the communities surrounding these sites?
- ? The Power Sector reforms envisage that CEB assets will be transferred to the 5 distribution companies to be formed, while liabilities will be transferred to “Z” company that will remain with the Government. Does this mean that the liabilities of CEB will remain a public liability that has to be met by the Government? I.e. The people who will never have access to the grid connected system will also indirectly have to pay for these liabilities? In the event of the new electricity distribution companies being sold to the private sector, will the profits generated by the sale of these companies be utilized to off-set CEB debts/liabilities?

### **General Recommendations**

- ? National policies should be a matter for the elected Government and not for Public Utility Commission of Sri Lanka (PUCSL).
- ? There is an urgent need for a comprehensive National Energy Policy. Such a document may be formulated by officials, engineers and scientists (preferably with local knowledge and experience) and must receive the approval of Government.
- ? PUCSL’s approach to off-grid electricity generation and distribution schemes should be developed in consultation with the Provincial Councils.

### **Specific recommendations**

- ? Off-grid renewable resource-based electrification systems below 100 KW should be given exemptions to generate and distribute electricity subjected to quality and safety standards set up by PUCSL.
- ? The National and the Provincial energy ministries should take the responsibility of setting up and management of the rural electrification fund.

## 2.5 Private-Public-Civil Society Partnerships in promoting renewable and rural technologies: The Sri Lankan Experience

**By taking the experience of World Bank's Energy Services Delivery Project (ESDP), this article shows that the private-public-civil society partnerships are the best way to provide off-grid energy services.**

### Electricity for Villages

The Ceylon Electricity Board's grid extension plan in Sri Lanka has increased grid-access to approximately 60% of the country's households. The Ministry of Power and Energy has an optimistic plan to reach 75% of Sri Lankan households by the year 2010. However, even if this goal is reached, approximately 1.5 - 2 million households in Sri Lanka still will not have access to grid-connected electricity. Off-grid electrification programs such as the World Bank's Energy Services Delivery Project (ESDP) and Renewable Energy for Rural Economic Development Project (RERED) have accelerated recently, increasing the number of solar home systems installed from around 3000 two years ago to 37 000 today. Off-grid village hydro schemes have increased from 40 to 160, providing electricity to about 5000 households. Off-grid energy technologies such as wind, biogas and dendro power (biomass-based electricity generation) have improved rapidly in Sri Lanka, even without the existence of funding mechanisms from multilateral agencies to facilitate the process.

### Experience of ESDP

The Energy Services Delivery Project (ESDP) was established in 1997. The lobbying process of Energy Forum, as a civil society organization, contributed in making the project private-sector driven. It also played a role in extending consideration to village hydro. In order to become eligible to participate in the ESDP Credit Program and to maintain their eligibility, credit institutions had to be privately owned and controlled. The mid-term review of the ESDP, however, revealed that after 2 ½ years of operation, the project managed to install only 550 SHS out of a targeted 32,000. The recent success in this sector as shown in the table is mainly due to deviations from the original ESDP plan. Those deviations ensured the participation of civil society and public-sector organizations in this private sector-driven project. Major deviations from the original plan include: SEEDS qualifying as a Participating Credit Institution (Civil Society Involvement), Contributions from Provincial Councils (Public Sector Involvement), NGO activists qualifying as Village Hydro Scheme developers (Civil Society Involvement), and Establishment of Federation of Electricity Consumer Societies (Civil Society Involvement).--

## Sri Lankan Off-Grid Energy Supply

Technology	Nature of the Technology	Energy Supply	Number of units installed	Costs per installed capacity 1kW	Potential Market
Solar Home System	Solar PV -Proven, Domestic level units. There are over 9 firms importing PV panels and components.	20-60W per household	37,000 households	US\$ 10,000	About 200,000 rural households have the capability to purchase SHS.
Village hydro	Community owned mini-grids; Locally manufactured turbines; Head between 20-50m. There about 15 manufacturers and 30 developers	Capacity 3kW- 50kW. Number of households per scheme: 10-150. Power available per household 100W- 250W.	Total number of schemes - 150. Around 5,000 households electrified.	US\$ 2,000	About 1000 villages covering 30,000 households.
Wind Home Systems	Domestic level units. Currently at the Pilot stage. 1- trained turbine manufacturer	Capacity of a home system is between 200-250W.	15 pilot wind turbines installed.	US\$ 3,000	Limited potential sites to operate thought the year.
Biomass-Dendro power	Gasification Imported from India Community owned mini-grids, pilot stage	Capacity 3kW-35kW	2 pilot plants. 3kW for coconut estate & 35kW community project.	US\$ 3,000	Has the potential to provide electricity to all off-grid villages in Sri Lanka.
Bio-gas	Domestic level Chinese (linked with cattle sheds) and Dry batch (linked with Paddy farming-straw) type digestion. Generation of bio-gas is proven. Electricity generation with mini-grids - currently pilot testing.	One Ton and 2 Ton systems are widely used for bio-gas generation. Electricity generation- 450W and 2.5kW (Pilot projects)	Bio-gas generation -1200 units. Electricity generation - 2 units	US\$ 3,000	Potential not estimated yet.

## Recommendations and conclusions

Off-grid energy services are private-sector driven. However, the capacity of the private sector is not sufficient enough to cater to the needs of the entire off-grid community. Development of partnerships to include public institutions and civil society organizations in the process will enhance the capacity to cater to a wider target group. This is the main reason for the off-grid energy sector's great leap forward during recent years.

The strengths and contributions of each sector are as follows:

- Private sector** : in providing technology, energy services (for a fee) and after sale services for a fee (Service Companies)
- Public institutions** : in developing a master plan incorporating grid extension and off-grid energy technology, in linking potential end-users with civil society organisations and the private sector, in establishing one-stop-shops for clearances, and in monitoring after sale services
- Civil society organisations** : in providing micro-financing, in mobilizing the community, in organizing end users, in conducting R&D, and in monitoring after sale services

## 2.6 Energy Partnerships in Global Village

**Under the Global Village Energy Partnership (GVEP) more than 150 organizations from developing and industrialized country governments, public and private organizations, multilateral institutions, consumers and others have come together to increase access to affordable modern energy services for rural populations. The Energy Forum, the local partner of the initiative, in collaboration with the U.S. Agency for International Development and CORE International, Inc., is establishing the GVEP Working Group and Developing an Initial Action Plan for Enhancing Sri Lanka's Participation in the GVEP.**

### What is GVEP?

The Global Village Energy Partnership (GVEP) was launched at the World Summit on Sustainable Development (WSSD) in Johannesburg, South Africa. As the newest global energy initiative, GVEP is intended to assist developing countries through the provision of grants and financing with the target beneficiaries being the least economically and most needy populations. The Partnership will help achieve the internationally recognized Millennium Development Goals. GVEP aims to help reduce poverty and enhance economic and social development for dozens of millions around the world. Its work will be carried out under a 10-year "implementation-based" program. The parties **involved are:** donor governments (Australia, Canada, Denmark, France, Germany, Italy, the Netherlands, Sweden, United Kingdom, and the United States); developing countries (Belize, Brazil, Chile, China, Costa Rica, El Salvador, Ghana, Guatemala, Honduras, Mexico, Nicaragua, Pakistan, Panama, the Philippines, South Africa, Sri Lanka, Thailand, Uganda, and Zambia); international organizations (the World Bank, UNDP, UNEP, Organization of American States); private sector (more than 50 private companies, worldwide); civil society (around 75 organizations, worldwide); USAID is a co-sponsor of the program.

### GVEP "on-demand" services

- ? Development of *Action Plans* as the 'implementation vehicle' for energy related activities set forth in national and/or local poverty reduction strategies and development plans
- ? *Knowledge Management and Transaction*, a service that will enable the sharing of information on innovative approaches, lessons learned and best practices for improved energy service delivery, while providing a forum for networking among partners

- ? *Capacity Development* for enhancing policy frameworks, entrepreneurial development, consumer organization, and credit systems aimed at expanding the number and the capabilities of enterprises operating in rural markets
- ? *Funding Facilitation*, working with a broad range of local, bilateral and multilateral financiers, expanding existing programs and financial instruments to better suit the needs of investors and energy consumers
- ? *Results and Impact Monitoring and Evaluation*, tracking energy services and their impact on poverty reduction and sustainable development, while enhancing partner accountability for tangible results.

### **GVEP Sri Lankan Programme**

The U.S. Agency for International Development in Washington, D.C. has retained the services of CORE International, Inc. to begin initial activities and support the GVEP work in Brazil, Mexico, Sri Lanka, and Zambia. CORE will provide assistance to Sri Lanka by facilitating the undertaking of steps that will enhance Sri Lanka's active participation in the GVEP initiative, and has retained Energy Forum as the local partner to support all activities in Sri Lanka.

### **Activities of the 1<sup>st</sup> Stage in Sri Lanka**

- ? Reviewing the current status of Rural Electrification (RE) and Rural Energy Service (RES) delivery in Sri Lanka and preparing a status report
- ? Working with the Sri Lankan stakeholders (government ministries, private industry, consumer associations, private rural energy service providers, academic institutions and NGOs) to identify candidates for a GVEP Working Group and proposing to the Government to informally establish this Working Group.
- ? Establishing the GVEP Working Group and the initiation of in-country consultation with the GVEP Working Group and other stakeholders
- ? Conducting a one-day workshop for the GVEP Working Group on the GVEP process and developing a blue print for a GVEP Action Plan
- ? Supporting the GVEP Working Group for the Development of an Initial Action Plan for Enhancing Sri Lanka's Participation in the GVEP

Once the GVEP Working Group has developed an Action Plan it will be submitted to the Secretary, Ministry of Power and Energy in order to facilitate a dialogue between the Ministry and the GVEP Secretariat for funding of specific proposals.

## ENERGY APPLICATIONS

### 3.1 Electricity for Wadagahakiwla: The first Ever Dendro Plant in a Sri Lankan Village



Energy Forum is in the process of installing a 40kW pilot dendro power plant in Wadakahakiwla village in Moneragala District, the first ever in Sri Lanka in an off-grid community setting. The community operated power plant provides 250W of environmentally healthy electricity to 100 households, while the necessary technical and institutional infrastructure to operate, maintain, and monitor and evaluate it are provided by the Energy Forum.

#### A convincing Case

The case for dendro power is convincing. Sri Lanka's energy research community has invested considerable resources to evaluate the potential of deriving electricity from dendro power (burning fuel wood). The Ministry of Science and Technology, the Ministry of Environment, ITDG, and the Energy Forum have already carried out pre-feasibility studies, which indicate strong dendro power potential. The next step in the development of dendro power was to implement a pilot-scale, fully functional dendro power plant for off-grid community electrification.

#### Wadagahaliwla

Wadagahakiwla is a village in Karadagama Grama Niladari Division in Badalkumbura DS Division in Moneragala District. Villagers of Wadagahakiwla showed a high level of enthusiasm and support for a dendro power project and formed the Wadagahakilua Dendro

Power Electricity Consumer Society to establish and operate the first ever off-grid dendro power plant in Sri Lanka. Community members contributed information and assistance to the feasibility study team during the study period and participated and contributed in civil works during the construction period. Once the power plant is operational the running cost will be paid directly by the consumers.

### Project details

Power plant capacity	40 kW	Fuel wood species	Gliricediya Sepum
Net out put	35 kW	Operation hours per day	6 hours
Transmission losses	@ 15%	Annually fuel wood requirement	160 MT
Net Power	29.75 kW	Available annual fuel wood out put	280 MT
Per h/h power allocation	250 W	Area targeted to collect fuel wood	2 km radius
No of house holds	100	Area targeted to electrify	2 km radius
Total h/h requirements	25 kW	Monthly electricity cost per h/h	Rs 412.00
Excess power to future use	4.75 kW	Expected revenue from fuel wood per h/h	Rs 238.33

### Dendro Conversion Technology

Processed and partly dried fuel wood, which is subjected to burn under controlled conditions, produces a specific gas called producer gas. This gas, which contains 19% combustible CO, activates an internal combustion engine to turn an alternator, which is coupled to the engine. Engines that are designed to run on diesel and liquefied natural gas (LNG) are capable of running on dendro producer gas. For the power station to operate it requires access to water, storage facilities for fuel wood to be kept in a proper dry state and access to roads to bring fuel wood.

For a period of 2 years the Energy Forum will closely monitor and assist the facility and the supporting infrastructure. During this period the Energy Forum also ensures the community-based Electricity Consumers Society has sufficient organizational capacity and funding mechanisms to take responsibility for the plant operations on a sustainable basis. Since Wadagahakiwla is in the dry zone of the country the outcome of the project can be adapted to other areas in the same climatic zone. The Energy Forum also expects that the Wadagahakiwla experience will motivate parties to come into the business as out-growers for off-grid power generation.

**Funding** - GEF- SGP Sri Lanka, Ministry of Science and Technology and RERED Project provide funding.

### 3.2 New Mixture Brings 1/3 Cost Reduction in Brick Making: Wilgamuwa Brick Project

**Instead of using clay as the only raw material, a mixture of clay and agro-residue can be used to produce high quality bricks at a lower cost. This is the result of the Energy Forum's brick project in Wilgamuwa. Project partner - GIDES Financial Assistance - GEF/SGP / ITDG (South Asia)**

Owing to the scarcity of clay and firewood and their rising cost, many brick-makers in Sri Lanka closed down their brick enterprises during the last few years. The brick-makers who are continuing their production have resorted to produce under-sized bricks and use less firewood for burning them, resulting in low quality and under-burned bricks.

The project implemented by the Energy Forum was designed with the objective of showing how stronger bricks could be made at a lesser cost by using agro-residue both as a mix in brick clay, and as an energy source in burning raw bricks with altered kiln construction and firing cycle, leading to a saving on clay and firewood.

Energy Forum selected 5 brick makers from Wilgamuwa village in Hambantota District and introduced residue/clay mix, who were until then using 100% clay. It is a mixture of 25-30% agro-residue with clay. They have fired over 30,000 residue/clay mixed bricks since then and now use the technology with confidence.

The pilot project results were as follows.

No. of work days reduced for firing 5000 bricks	- 7-4 = 3
Reduction in the amount of paddy husk required for firing 5000 bricks	- 100- 68 = 32 bags
Cost reduction for paddy husk for making 5000 bricks	- Rs. 1500- Rs. 1000 = Rs. 500
Cost reduction for Labour cost for making 5000 bricks	- Rs. 1400 - Rs. 800 = Rs. 600
Total Cost reduction of 5000 bricks	- Rs. 1100
<b>Percentage cost reduction for making bricks</b>	<b>- 1100/2900 *100 = 38%</b>
<b>% saving on clay and use of agro residue</b>	<b>- 25% -30%</b>
<b>Other advantages observed by the brick makers:</b> Bricks are lighter, easy to handle, Number of condemned bricks (due to cracks) reduced, saves time and hence increases productivity, greater demand due to improved quality.	
<b>Total increased profit for 1000 bricks</b>	<b>- Rs. 420</b>



### 3.3 Stakeholders Recommend Solutions to the Problems Faced by the Village Hydro Industry



**The Micro Hydro Industry in Sri Lanka has gone through a vast transformation in recent years. While this rapid expansion has been a blessing to many remote villages it has also brought with it its own set of problems and challenges.**

**The best method of uncovering the various problems and conflicts is by creating an open forum in which all involved parties could voice their issues and receive feedback. The Study Report is a result of several such forums conducted by the Energy Forum.**

#### **Village Hydro**

From just a handful of projects strewn across the country, the village hydro industry has grown from strength to strength in a remarkably short period of time and now embraces more than 160 projects in four Provinces. While this rapid expansion has been a blessing to many remote villages it has also brought with it its own set of problems and challenges. Throughout the sector the involved parties face their own common difficulties. Most of these are due to the lack of understanding and cooperation between parties. The Energy Forum created several open forums for all involved parties to voice their issues and receive feedback as this is considered the best method of uncovering the various problems, compare them and find solutions.

The expansion meant that there was ample opportunity for new Developers, Equipment Suppliers, and other service providers to enter the industry. Unfortunately there was no proper planning in place at this stage with regards to the standards of technology they supplied, their duties as service providers, their connections to the Provincial Councils, and various other issues. These newcomers

were left more or less to their own devices, dealing with their own problems individually as they arose, in some cases causing even more hardship for the rural population.

There are various institutions providing the consumer societies responsible for operating village hydro projects, with instructions, technical assistance and financial aid. But once the project is completed and the people have been provided with the required electricity, the village societies get isolated. This is what has happened for about a decade now. They get stranded in the face of problems and challenges that crop up during implementation of the project. Therefore we can see many projects that have consequently become unsuccessful.

### **Recommendations**

For further development as well as the strengthening of stakeholders it is vitally important that the following recommendations be implemented with a holistic approach to the industry.

- ? The role of Provincial Councils in the micro hydro process should be evaluated and given proper recognition.
- ? Provincial and Divisional level maintenance technicians should be identified and trained.
- ? An awareness campaign should be conducted among villagers to avoid them being exploited by false developers.
- ? Developers and Equipment suppliers should be licensed and registered. Prior to licensing and registration, it is essential to evaluate the human resource capabilities with regard to technical and social mobilization skills of all developers and raising the level of recognition for the services they have already rendered.
- ? Concrete poles, meters and safety equipment should be included in the preliminary project estimates by the Equipment Suppliers.
- ? The civil constructions of village hydro schemes need professional guidance. The developers should be able to claim such expenses from the World Bank funded RERED Project.
- ? Training programs are needed for Consumer Societies in leadership, accounting, maintenance and other areas.
- ? The equipment suppliers should become an established organization.
- ? The Pattern for turbine buckets within the 190-250 range should be made available to the equipment suppliers.
- ? Training Programs for Turbine design are needed for Equipment suppliers.
- ? Low-head technology should be made available in the country.
- ? Technology should be available for linking the off-grid system to the national grid while the grid is extended to the VH scheme.

Financial Assistance for the related activities - Hivos, ITDG (South Asia), USAID-SARI/CORE Internatioan, LGA Consultants

## ENERGY FOR THE WAR-AFFECTED

### 4.1 Taking Decentralized Energy Technologies to the War-affected East: Energy Forum in Batticaloa



The Energy Forum works extensively in Batticaloa district for the promotion of renewable technologies such as solar, bio-gas, and dendro power. The wide range of work covers introduction of credit schemes, conducting awareness/ training programmes, need assessments, and organising field visits, etc.

The Energy Forum implements this NORAD-funded project both in government-controlled and LTTE-controlled areas.

#### **An Introduction to Involvements of the Energy Forum in Batticaloa**

The electrification rate in Uva and the Northeast provinces of Sri Lanka are the lowest in the nation, with a rate of 30%. There are a number of reasons for this situation. The major reasons are the low population density and the war that existed for the last two decades. The extension of the national grid in those provinces is uneconomic and unrealistic.

The Energy Forum's involvement in Batticaloa is two-fold. On the one hand the Forum is involved in building the capacity of Community Based Organizations in Bio-gas, paddy husk-fired bakery technologies and Solar PV technologies, as well as in installing Solar PV and Bio-gas units in selected locations as demonstrations. Additionally, the Forum is in the process of developing proper lending mechanisms and networking interested parties to ensure sustainable expansion of the technologies. Some of the achievements up until now are listed below.

### **Solar Home Systems (SHS)**

- ? Trained 7 technicians to install SHSs.
- ? Organized discussions among Micro-finance institutions, SEEDS and Seylan Bank Officials to establish lending for SHS in Ottumawadi, Vallachchanai, Chenkadaly, Vahari, Pattirupu, Wellaweli, Chittamawadi, Mahaweliaru, and Kokkadicholei.
- ? Installed one SHS each in 8 DS divisions in the Batticaloa District initially, to be followed by 12 more systems.
- ? SEEDS provided lending for 200 Solar Home systems and Seylan Bank provided lending for 20 units in the Batticaloa District. 138 more applicants are now in the queue to link with the lending mechanism to get SHSs.

### **Bio-gas**

- ? Trained 11 masons for constructing Bio-gas units and a field officer for diffusing Bio-gas technology.
- ? Constructed a Chinese type bio-gas unit at Mahaweli Aru to generate electricity to light 2 households.
- ? Provided technology to construct a Chinese type bio-gas unit in the Batticaloa town.
- ? Completed a feasibility study to establish a Dry Batch type bio-gas system to provide electricity to 18 households in Pawakkodichchei village.

### **Dendro Power**

- ? Completed the feasibility report to establish a dendro power plant in the Unit-35 village in Batticaloa district.

### **Awareness Programmes/General Training Programmes**

- ? Conducted 9 awareness creation workshops on decentralised energy technologies in 10 DS divisions (Eravur, Manmuni, Valachchanai, Vagarai, Araimbadi, Vavnathiv, Pattipalai, Kaluvanchchikudi, Vellaweli) and trained 245 NGO and CBO leaders.
- ? Conducted a GEF/SGP Capacity building workshop in Batticaloa District for which 72 CBO/NGO leaders from 36 organizations attended.
- ? Conducted one-day workshops in Batticaloa, Kalkuda and Pattiruppu educational zones to 97 science and social science teachers. It as an awareness training program on decentralized energy technologies

### **Low Cost/Renewable Technologies**

- ? Organized a field-visit for 9 bakery owners to a paddy husk-fired Bakery in Dehiattakandiya and constructed a Paddy husk-fired kiln at Sajith Bakery in Kottadurie Village in Chenkaladi.
- ? Investigated the need for finding a solution to the high kerosene consumption of the fisheries community in the Batticaloa District, and is in the process of developing a suitable solar PV package.