Mini/micro hydro to support rural development in Bhutan – a GEF baseline study

by Anders Arvidson (SEI); Bernt Rydgren, (SwedPower International); Pema Norbuand and R.N. Adhikari (Independent Consultants, Bhutan)

The goal of the mini/micro hydro programme in Bhutan is to improve energy services in support of rural development without harming the idyllic environment and rich cultural heritage. Photo: Anders Arvidson.

Rural residents of Bhutan depend highly on fuelwood and kerosene for their energy needs. Electricity could improve the availability and quality of basic energy services such as lighting and cooking. A recent Global Environment Facility (GEF) baseline study examined the potential for mini/micro hydro plants to provide electricity and promote development in remote and rugged areas of Bhutan without disturbing the serene environment.

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Fuel-Wood Farming

The scene depicted in the July 1999 issue of Renewable Energy for Development is all too common in the developing world. Forest resources have been seen as quick sources of profit rather than as long-term sustainable sources of income. Trees are chopped down for export as timber when they could be more profitably utilised within the context of long-term managed growth. In the case of trees used domestically for fuel-wood, trees have too often just been felled and then laboriously chopped or chipped into smaller sizes as required for the furnace or hearth.

A more sustainable approach can be found in the fuel-wood farming technique of periodically coppicing (or pollarding – in the tropics) only the larger branches – and thereby enabling the trees to keep growing throughout the year as they do in the tropics. Tree-farming (rubber, cocoa, coconut, palm oil, tea, etc.) has long proven the most sustainable and profitable farming system in the tropics. Fuel-wood farming in temperate countries, such as with Willow or Poplar, usually involves harvesting only once a year (during the winter) when the coppices are cut at the base using a tractor-mounted cutter-bar, and are then lifted by grab onto a trailer for transport to the generating station. The alternative in the tropics of periodically (every four months or so) pollarding only the larger branches at ‘chest-height’ offers a more environmentally sustainable system, whereby the fuel-wood farm never “loses its (green) cool.” Most of the species being thus evaluated have proven sustainable for decade after decade – never having to be replanted. Fuel-wood farming is thus most appropriate in the tropics.

The social circumstances throughout most of the tropical world suggest a great need for programs of gainful employment for rural populations. Even a three-hectare fuel-wood farm can provide a reasonable and sustainable income from rain-fed ‘uplands’ which might otherwise suffer from the more traditional and highly erosive ‘slash-and-burn’ farming systems. The sticks or branches that are thus manually harvested (about 3 to 4 cm diameter) are laid on the ground to dry and are ready for the furnace, with the foliage chopped for forage or else left as mulch to re-cycle and improve fertility.

We have had many years of ‘environmental’ and ‘energy’ association with Stockholm Environment Institute and the Beijer Institute over the past several decades. We look forward to continue to work together in encouraging profitable and sustainable energy solutions like fuel-wood farming.

Ray Wijewardene, M.A. Cantab., D.Sc. C.Eng
Colombo, Sri Lanka

The Puzzle of Consumption, Development and Sustainability

The economic development of a country is dependent upon sustainable use of natural resources. The rapid growth of human population and its increasing pressure on these resources has posed a considerable challenge. Tanzania recognizes the need to pursue development policies and strategies that are friendly to the environment in order to ensure sustainable growth, but needs more support in overcoming the obstacles.

Poverty and the accompanying ignorance of natural resource degradation present major obstacles to sustainable development. In Tanzania, about 50% of the population live in poor conditions, while 36% live in abject poverty. Small holders and pastoral groups have intensified exploitation of land, contributing to widespread soil erosion. Firewood and charcoal remain the dominant energy sources. These factors contribute to deforestation and desertification. In Tanzania, the official annual rate of deforestation is 400,000 hectares.

Despite living under the scorching sun of the tropics, we have been unable to tap and utilise solar energy. The number of cattle in Tanzania is equal to half of the population, (i.e. 15 million cattle) but we have been unable to make significant use of biogas. Increased utilisation of renewable energy in Tanzania remains constrained by poverty, underdevelopment and ignorance.

The Local Agenda 21 as well as other conventions call for practical action. Among the policies pursued in Tanzania is a national program of tree-planting, with the goal of planting five trees for each one cut. This program, if implemented, offers some hope for the rejuvenation of Tanzania’s forest resources.

One should not marginalise the international efforts to safeguard biological diversity and natural resources. But one must ask whether current rates of exploitation and consumption and development have any relation to the sustainability vision? The current trend is for consumption patterns that require far more resources than the sustainable development we envision. Until we utilise resources at the optimum point in the present, consideration for future sustainability is simply a paradox or riddle!

M.I. Mfunda
GENERAL SECRETARY
ALAT, Tanzania
of Bhutan. The programme seeks to enhance the rural economy, improve living standards, and help protect the environment by replacing fuelwood, kerosene and diesel with electricity generated by mini/micro hydro plants. It is envisioned that mini/micro hydro in Bhutan could function as an effective tool for rural development.

**Baseline Study Commissioned**

A study was commissioned last year with the aim of preparing essential baseline information for a Global Environment Facility (GEF) funded mini/micro hydro programme. The project team (including Swedpower International and the Stockholm Environment Institute) was charged with investigating the energy service needs of rural and remote areas in Bhutan and relating these needs to the appropriate technologies and methods of implementation. The project team conducted a simple but comprehensive field investigation to assess site suitability from socio-economic, hydrological, environmental and technical points of view. The project specifically targeted remote sites where grid connections are likely to remain elusive over the next 10–15 years.

**Recommendations of the Study**

The project team recommended that preparations continue for implementation of mini/micro hydro schemes in four of the sites studied. Based on a combination of socio-economic impacts, environmental impacts and technical feasibility, the project team found that these sites have the greatest potential for success. Specific (see Box 3) programmatic recommendations dealt with expanded end-uses for rural electricity, concurrent efforts on rural business development, intensified hydrological gauging of small catchments, and more efficient technical design, maintenance and management.

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"A key Recommendation of the Study was to carry out a lessons-learned study of the existing 21 mini/micro hydro schemes in Bhutan"
The energy situation in rural Bhutan

Bhutanese rural households without access to electricity rely on five types of energy carriers: fuelwood, kerosene, dry cell batteries, animal power and human power (see Box 2). Fuelwood is used for cooking, space heating, animal fodder preparation and water heating. Kerosene is used for lighting and igniting fires. Dry cell batteries are used for portable light in torches and for powering radios and tape recorders. Animal power (and sometimes human power) is used for transport services and farming activities such as ploughing and threshing. The substitution of electricity for these energy carriers offers versatility in end-uses as well as positive socio-economic and environmental impacts.

Fuelwood

Fuelwood is the most common energy carrier and requires significant manpower to acquire. A rural household in Bhutan typically spends the equivalent of 25 person-days per year, cutting, splitting, drying and transporting fuelwood. This human power requirement competes or conflicts with the need for human labour in agricultural or other types of production, thus leading to a major constraint on development in rural Bhutan. All fuelwood that can be substituted is therefore likely to lead to improved livelihoods in Bhutan by freeing labour for more productive activities. Bhutan has one of the highest levels of fuelwood consumption per capita in the world, estimated at over 1 tonne/capita/year.

Kerosene

Kerosene provides better lighting service than fuelwood, but is costlier and generally more difficult to obtain. Kerosene has negative impacts on indoor air quality and human health, due to high emissions of smoke and particles. In Bhutan, indoor air pollution presents an even greater health hazard due to the fact that the climate often requires extensive space heating.

Dry cell batteries

Dry cell batteries are a practical but expensive form of mobile fuel that is used by rural Bhutanese when moving around at night and for powering radios and other small appliances. The high cost of dry cell batteries is financially constraining for rural Bhutanese households, but their popularity gives a good indication of how valuable a versatile fuel like electricity is considered in rural Bhutan. Dry cell batteries can constitute an environmental hazard unless they are recycled in a proper fashion.

Box 2: ENERGY CARRIERS AND ENERGY SERVICES IN RURAL BHUTAN

<table>
<thead>
<tr>
<th>Energy Carrier</th>
<th>Energy End-Use</th>
<th>Typical annual household consumption</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fuelwood</td>
<td>Cooking, Space heating, Water heating, Animal fodder preparation</td>
<td>12 tonnes</td>
</tr>
<tr>
<td>Kerosene</td>
<td>Lighting, Ignition of fires</td>
<td>80 litres</td>
</tr>
<tr>
<td>Dry cell batteries</td>
<td>Mobile lighting, Small appliances</td>
<td>50 pairs</td>
</tr>
<tr>
<td>Animal Power</td>
<td>Transport, Land preparation for farming, Food preparation (threshing)</td>
<td>-</td>
</tr>
<tr>
<td>Human Power</td>
<td>Transport, Land preparation for farming, Food preparation (threshing)</td>
<td>-</td>
</tr>
</tbody>
</table>

The project team conducted participatory exercises with local residents in order to learn about household characteristics and energy service requirements. Photo: Anders Arvidson.
A “lessons-learned” study is needed of all aspects of implementation and management issues for the existing 21 mini/micro hydropower plants in Bhutan.

The next project phase should focus strongly on institutional, financial and other managerial aspects of rural mini/micro hydropower in Bhutan.

Intensified hydrological gauging programme for small catchments.

Initiate pre-feasibility study on providing enough power to satisfy peak demand in Gasa.

Plant caretakers should receive extensive training to enable them to handle all scheduled maintenance and most common repairs.

Create repair and maintenance fund for each plant to insure spare parts availability.

Conduct detailed investigation of grid extension costs in different areas of Bhutan.

New mini/micro hydropower plants in Bhutan should have semi-automatic technology.

Include thorough geo-technical surveys in all site investigations for mini/micro hydropower.

Excess heat generated from the plants might, together with the caretaker’s house, be used for demonstration of modern heating and insulation methods.

Proactive efforts should be made to enable electrified rural households to use electricity as much as possible, also for non-lighting purposes, such as for heating and cooking.

Activities geared at stimulating business development should be introduced simultaneously with the electricity at the sites to be electrified.
Growing Our Own Green Energy
Complementing Hydropower for Sustainable Energy and Rural Employment in Sri Lanka

By Ray Wijewardene and P.G. Joseph (Sri Lanka)

Like many tropical countries, Sri Lanka has ample biomass resources that can be efficiently exploited in a manner that is both profitable and sustainable. Fuel-wood farming offers cost-effective and environmentally friendly energy solutions for Sri Lanka, with the added benefit of providing sustainable livelihoods in rural areas. This article provides an overview of production and harvesting techniques for fuel-wood farming and describes the economic basis and institutional framework for expanded fuel-wood farming in Sri Lanka.

As is true in most countries of the world, the main renewable energy resource for electricity generation in Sri Lanka has been hydro-electric power. As Figure 1 shows, hydro has historically provided a significant share of electricity needs without contributing to costly foreign exchange requirements. The Sri Lanka Rupee (Rs.) has devalued from less than 20 Rs./$ in 1979 to more than 70 Rs./$ today, and there is no sign that this devaluation will be reversed. At the same time, the prospects for greater exploitation of hydro sites in Sri Lanka are now considerably constrained. If fossil fuel based thermal generation were to increase to meet expected growth in electricity demand out to 2015, the foreign exchange crisis would become ever more acute.

Earnings from key exports (tea, rubber, and coconut) have helped to reduce the trade imbalance, but as Figure 1 shows, these earnings could easily be overtaken by fossil fuel imports between 2006–2008. Such a situation would reduce the flexibility to utilise foreign exchange for vital imports of food and trans-
port sector goods and services. Sri Lanka therefore would benefit greatly from a more rapid expansion of domestic energy resource. Some renewable alternatives such as wind and solar PV can certainly play a valuable role, but their high up-front capital cost and intermittent availability will likely limit their contribution to isolated locations. Fortunately there is a viable alternative in the form of fuel-wood farming, but it will probably take several years to develop it.

**Fuel-Wood Farming and the Environment**

In some cases, when wood is suggested as a major fuel for thermal generation of electricity, horrifying visions arise of forests being chopped down and burned. Although that might have been true thirty years ago, today fuel-wood farming is emerging as a new form of sustainable agriculture. Quick-growing and coppicing trees grown by farmers for fuel have spurred one of the fastest growing and most environmentally-friendly sources of energy in Europe, the U.S., China and elsewhere. It is taking over from disbanded fossil-fuel plants all over the world as a more cost-effective way to generate power, and it is proving to be especially well-suited to the tropical regions of the world. Where practised sustainably, fuel-wood farming will result in zero net CO2 emissions, thus helping to mitigate future climate change.

**Available Land**

Fuel-wood farming is particularly well suited to the humid-tropical climate of Sri Lanka, where the growing of trees has proven to be our most effective form of agriculture. The growing of tea, rubber and coconut trees on our uplands (known as haena's) has sustained our nation’s economy for well over a century. Furthermore, erosion from plantation lands is a tiny fraction of that from the short-term arable (cultivated) crops, which are often also grown on hillsides. The availability of haena and scrub lands has special relevance in the context of land-use distribution in Sri Lanka (see Box 1).

Forests still cover more than a quarter of the land, while plantation crops and paddy lands each occupy about 12%. About 1.7 million hectares (the sum of haena and scrub lands in Box 1) or 28% are currently only marginally utilised, which is an amount even greater than the forested lands. These hitherto sparsely-utilised haena and scrub lands have been identified all over the country in the Forestry Master Plan. While inappropriate for the growing of food crops, most of this ecological terrain is well suited to the farming of fuel-wood, multi-purpose trees and complementary arable crops.

**SRC Species identified**

Many fuel-wood tree-species have been identified for suitability to the various agro-climatic zones of the country as SRC (Short-Rotation-Coppicing)—through trials conducted by researchers in Universities and in the Departments of Forestry and Agriculture. Most of these species are nitrogen-fixing and thus offer special benefits to the soil. Coppicing is a term used to define the ability of certain trees to throw out a profusion of branches (coppices) from just below their level when lopped. The coppiced branches are themselves lopped (harvested) when reaching 3–5 cm. in diameter. This is the ideal size for use as fuel-wood, eliminating the earlier need to: (a) wait several years until a tree grew into a large trunk; and (b) chop it into small pieces – the customary dhara-mitiya size – to be used for the furnace or stove.

**Box 1: LAND USE DISTRIBUTION IN SRI LANKA**

<table>
<thead>
<tr>
<th>Land Use</th>
<th>1000 hectares</th>
<th>Share of Total</th>
<th>Examples or Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Natural forest</td>
<td>1678</td>
<td>26%</td>
<td></td>
</tr>
<tr>
<td>Forest plantations</td>
<td>81</td>
<td>1%</td>
<td></td>
</tr>
<tr>
<td>Industrial plantations</td>
<td>769</td>
<td>12%</td>
<td>tea, rubber, coconut</td>
</tr>
<tr>
<td>Paddy lands</td>
<td>799</td>
<td>12%</td>
<td></td>
</tr>
<tr>
<td>Sparsely used crop lands</td>
<td>1263</td>
<td>19%</td>
<td>haena lands</td>
</tr>
<tr>
<td>Range scrub land</td>
<td>502</td>
<td>8%</td>
<td>scrub lands</td>
</tr>
<tr>
<td>Other land uses</td>
<td>1408</td>
<td>22%</td>
<td>urban, housing, roads, shore, rivers, mountains</td>
</tr>
<tr>
<td><strong>Total land area</strong></td>
<td><strong>6500</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

continued on p. 8
weighed (for payment to the farmer) and then tipped directly into the loading hopper to be fed into the furnace.

Within about six months or so (in the tropics) fresh branches (coppices) have grown radially and upwards from below the initial lopping of the tree and are ready for harvesting once again. By contrast, in the temperate countries harvesting takes place annually and then only in the winter months. The coppicing cycle of re-growth, lopping and re-growth again is continuous and is known to extend at least ten years, with re-planting possibly needed after this period. The need for added fertiliser is minimal and usually limited to phosphate and potassium, which are the main nutrients removed from the soil when growing the fuel-wood. A mix of species is encouraged for improved growth and to minimise ecological disruptions. Wildlife—including birds and small animals—quickly find an ideal home in coppice forest plantations due to the minimal disturbances and the allowance for natural cycles.

Energy Yield
Under moderately favourable conditions, one hectare of SRC-farming could yield over 25 tonnes of dry-matter per year, a more conservative yield figure is 20 tonnes/ha/yr. Considering just 500,000 hectares, (less than one-third of the total scrub-land terrain), this land could produce 10-million tonnes of fuel-wood annually. This quantity of fuel-wood could generate 10,000 GWh annually, with 1,200 MW of power. All of this adds up to nearly twice the known hydropower potential, and still we have assumed use of only one-third of the under-utilised land that is available!

Pricing Issues
With respect to energy content, 4 tonnes of fuel-wood are approximately equivalent to 2 tonnes of coal or 1 tonne of oil. At current prices for oil of around Rs. 6,000 per tonne, the energy-equivalent price of fuel-wood would be about Rs. 1,500 per tonne. Not surprisingly, this is roughly the current (delivered) price paid for fuel-wood. As the price for imported oil or coal continues to escalate, the price for domestically grown fuel-wood becomes increasingly more attractive. A rough figure for the electrical power that can be sustainably produced from SRC fuel-wood farming is about 1 kW (kilo-watt) per acre.

Electricity generated by a 10MW wood-fuelled power station is likely to cost US cents 4.85/ kWh. Although this figure is slightly higher than the estimated price for a large coal-based power plant, it is still much cheaper than present oil-based power plants. Furthermore, fossil-fuel-based electricity is likely to escalate in cost.
with further currency devaluation and tighter constraints in world oil markets.

Wood-fuelled generating stations of 1–20 MW would normally be dispersed across the country and in proximity to both energy-plantations and consumers. Transmission and distribution losses are thereby minimised. By contrast, large fossil-fuel-based power stations will generally be located around the coast, requiring costly transmission lines and resulting in transmission and distribution losses. Inevitably, the delivered cost of fossil-fuel-based energy will therefore proportionately increase.

**Energy Security**

Given constraints on further hydro development, coal-fired power plants are already being proposed at coastal locations to meet immediate power needs. The coal plants are initially planned to produce 150 MW, rising in the long-term to over 1,000 MW. Such large-scale dependence on imported energy resources will leave the nation vulnerable during periods of domestic and international conflict. The nation would be far less vulnerable when power is supplied to the grid from a number of smaller (1–20 MW) power stations located all over the country. The fuel-wood plantations could be designed to supply the electricity needs of a town using a 400 hectare, 1 MW plant or an entire District using a 3600 hectare, 10 MW plant. By way of comparison, the Udawalawe hydropower station has a design output of only 6 MW.

**Employment**

Fuel-wood plantations could have significant benefits for rural employment. In the two examples given previously, 130 and 1000 families, respectively, would be continuously employed in supplying fuel-wood. The work would be part-time and would not interfere with the seasonal efforts needed for paddy cultivation or for remunerative work in local industries. Just 3 hectares of land conveyed to a family for growing fuel wood would conservatively produce 60 tonnes of fuel-wood annually. Even at the present delivered price of Rs. 1,500 per tonne, the fuel-wood represents an annual income of nearly Rs. 90,000.

For the country as a whole, if we assume again that 500,000 hectares of marginal haena and scrub land are available, the fuel-wood industry would provide continuing productivity – and very remunerative ‘base’ employment – for 150,000 rural families – about 5% of the present population. It would improve rural social and cultural life by helping to reverse the current drift of rural youth to towns through a local and profitable income source. This employment would become available to them in a healthy rural environment spread throughout the country rather than crowded into factories as seen in the ‘western’ pattern of industrialisation.

**Conclusions**

Even with modest assumptions about the availability and productivity of land, a comprehensive fuel-wood farming program for Sri Lanka offers significant energy, economic, and environmental benefits (see Box 2). These benefits would be dispersed in rural areas where they are greatly needed and can serve as linkages for further rural economic development. The nation as a whole would benefit from savings in foreign exchange, improved energy security, and socio-economic improvements. With a nine-fold increase in forest-plantation cover, the nation’s resource base would be greatly improved. The international community would benefit from pollution reduction, climate mitigation, and the increased trading opportunities that arise from new markets and new income sources.

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**Box 2: FUEL-WOOD FARMING SUMMARY FOR SRI LANKA**

| Land used | 500,000 hectares |
| Yield | 20 tonnes/hectare/year |
| Average hectares per family | 3–4 hectares |
| Rural employment | 150,000 families (5% of population) |
| Income Generated per Family | Rs.7,500 per month (US$100) |
| Power Produced per Station | 1–20 MW |
| Total Power produced | 1,200 MW |
| Total Fuel-wood produced | 10 Million tonnes/year |
| Total Electricity produced | 10,000 GWh |
| Foreign Exchange Savings | Rs.15 Billion (US$200 Million) |
| Forest-plantation cover | Nine-fold increase |
Energy efficiency standards and labels for appliances, equipment, and lighting products are a cost-effective means of conserving energy, and provide a valuable addition to a country’s energy policy portfolios. For more than a decade, Lawrence Berkeley National Laboratory (LBNL), the Alliance to Save Energy (the Alliance), and the International Institute for Energy Conservation (IIEC) have promoted energy efficiency standards and labeling programs in developing countries. In 1999, these three organizations formed the Collaborative Labeling and Appliance Standards Program (CLASP) to facilitate the design, implementation, and enforcement of energy efficiency standards and labels in developing and transitional countries throughout the world.

Efficiency Standards and Labeling Programs Can Help Meet Rising Energy Demand

Throughout the developing world, growth in demand for power is straining an already inadequate energy infrastructure, causing environmental damage and hindering economic growth. World demand for major appliances and equipment—ranging from refrigerators and clothes washers in homes to copiers, water coolers, and lighting equipment in office buildings—is expected to continue its steady growth. Without focused efforts to reduce energy consumption by appliances and equipment, electricity demand in the residential and commercial sectors will continue to grow rapidly in the developing world.

The growth in demand for energy services can in many cases be more cost-effectively met by improving the efficiency with which electricity is used rather than increasing the supply of electricity. Increasing energy efficiency in buildings is one of the most cost-effective means of helping countries meet their need for reliable energy services while fostering economic prosperity. Energy efficiency standards and labels can limit growth in energy consumption while stimulating innovation and providing environmental benefits. Energy savings will increase over time as the saturation of products increases, and these savings will translate into economic savings for consumers (see Figure).

A Global Program

CLASP’s mission is to promote efficiency standards and labels in developing and transitional countries through partnerships with agencies, stakeholders and relevant institutions in those countries. CLASP will invite representatives of countries that have successfully adopted standards to join the program in reaching out to neighboring countries. CLASP will also partner with a variety of policy and technical specialists from around the world, including representatives from European organizations, developing country non-governmental organizations (NGOs), testing laboratories, manufacturers, research organizations, and universities.

With support from USAID, the UN Foundation, the Energy Foundation, and US Department of Energy, CLASP is developing globally applicable technical and policy support tools, conducting regional workshops, and providing technical support to partner countries. In each participating country, the project will result in enhanced institutional capacity for implementing standards and labeling programs, increased production of energy-efficient products by manufacturers, improved average energy efficiency of appliances and equipment, significant reductions in electricity consumption, and lower energy-related emissions of greenhouse gases and other pollutants.

CLASP Builds Local Capacity and International Networks

CLASP works at the national level to build the skills and institutional capacity necessary to develop, enforce, and maintain standards and labels. National successes will help build a critical mass of knowledge, skills, and infrastructure in each region. Participation by multiple countries in the same region will exchange knowledge base and increase equipment trade flows. Working together with in-country host agencies and institutions, CLASP will formulate technical assistance programs to meet the differing needs of participating countries (see Box).

Workshops and Policy Support

Based on host country participation, CLASP will organize several regional workshops on energy efficiency labeling and standards, including a workshop in Latin America in mid-2000 and one in Asia in 2001. In addition to country-specific technical assistance and regional workshops, CLASP is developing support tools for policymakers whose role it is to support and promote performance standards. The tools include:

- A guidebook with practical steps for addressing, analytical, policy, legal, and regulatory actions necessary to establish a successful national labeling and standards program;
Steps in the Development of Customized Technical Assistance Programs

- Determine a country’s ability to commit its own resources to match those of CLASP in developing and implementing standards and labeling programs.
- Conduct needs assessments with relevant agencies in participating countries to determine the types of equipment for which energy efficiency standards and/or labels will be developed and implemented.
- Design a comprehensive set of technical assistance services, including:
  - Policy, analytical, logistical, and advocacy support;
  - Training, education, and compliance programs for manufacturers, government officials, industrial designers, advocacy groups, trade associations, and other stakeholders;
  - Design services and equipment for establishment of testing facilities;
  - Direct assistance in the design and specification of equipment testing procedures, labels, and efficiency standards.
- Track progress toward standards and labels development and facilitate cross-fertilization among the countries, particularly from a regional perspective.

- A toolkit of training and marketing materials intended for government, industry, NGO, and advocacy groups that includes presentations, brochures, and examples of existing labels and standards; and
- An Internet web site for the guidance manual and toolkit training materials. The site will also provide access to numerous reports, include updates on implementation in different countries, and link with other standards and labeling-related sites worldwide.

CLASP Partners
The three CLASP founding partners – the Alliance, IIEC, and LBNL – have a proven record of work in domestic and international development and implementation of efficiency standards and labeling programs. Jointly they have expertise in coalition-building, policy advocacy, regulatory support, technical training, capacity-building, regional network-building, and engineering and economic analysis.

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Figure 1: Estimated Potential Energy Savings in Ghana for standards enacted in 2000

These projections assume the following:
- 10% savings on lighting energy per household
- 10% savings on new Room Air Conditioners (RACs)
- Assume current EU standards for Refrigerators
- 6.8% annual increase in saturation for Refrigerators and RACs
- Urban saturation for lighting = 100%
- 20% annual increase in rural saturation for lighting

The Stockholm Environment Institute (SEI) is an international research institute focusing on local, regional and global issues related to environment and development.

The scientific and administrative work of the Institute is co-ordinated by SEI’s headquarters in Stockholm, Sweden, with centres in Boston (USA), York (UK), and Tallinn (Estonia).

In addition, SEI works with an international network of independent scientists and research institutes located throughout the world.

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Call for Applicants

Visiting Developing Country Professional Program

The Stockholm Environment Institute will award an internship to a candidate to do research related to energy, environment and sustainable development. The objective of the internship is to enable developing country professionals to develop and implement a specific project relevant to sustainable energy issues in their home countries and to disseminate the results of their work.

Eligibility

Professionals with a university degree may apply. Candidates must come from a developing country and work in a local research institution, utility, NGO, consultancy company or government organisation. Experience with energy and environment issues and proficiency in English are essential.

General conditions

The internship will cover six to ten months of study. Candidates should plan to be available for the internship during the period between August 2000 and June 2001. The exact length and timing of the internship will depend on the project proposal and the support available. The candidate is expected to develop an analytical framework for the study during an initial period spent at the SEI in Stockholm. Staff will provide support in designing the project approach, methodology, and workplan. The candidate will then carry out field work based on the project workplan. At the end of the study, the candidate will finalise a project report and present the results of the study. The candidate is expected to return to his/her home institution after the internship.

Application procedure

Applications MUST contain (1) a three-page proposal for a research idea in the field of energy, environment and development; (2) Curriculum Vitae of the candidate; (3) two letters of recommendation. A preliminary selection will be made based on the research idea presented, and the selected candidates will be asked to develop their initial idea into a full project.

Application date

Applications can be sent by mail or e-mail. Applications sent by regular mail should be postmarked by 8 May 2000. Applications by e-mail should be in MS-Word software and should be received by 15 May 2000. Only candidates that fulfill the eligibility criteria and send complete applications will be considered. Applicants will be notified of acceptance or rejection in June and are expected to reply within two weeks of notification.

Please send your application to:
Stockholm Environment Institute
Solveig Nilsson, Box 2142, 103 14 Stockholm
tel:+46-8-412 14 00, fax:+46-8-723 03 48
e-mail: solveig.nilsson@sei.se

* three pages is MAXIMUM – longer proposals may be penalised.