Renewable Energy Project Toolkit for World Bank Task Managers

Case Study

Sri Lanka Renewable Energy Program

Government of Sri Lanka, World Bank and GEF supported Sri Lanka Energy Services Delivery (ESD) project and Sri Lanka Renewable Energy for Rural Economic Development (RERED) project

www.energyservices.lk

1. Overview

The Sri Lanka Renewable Energy Program is a World Bank and Global Environmental Facility (GEF) assisted program through two investment projects, the Energy Services Delivery (ESD) project from 1997 till 2002 and the ongoing Renewable Energy for Rural Economic Development (RERED) project.

The principal objective of the program is promoting the provision by the private sector, NGOs and cooperatives of grid-connected and off-grid energy services using environmentally sustainable renewable energy technologies. The program supports the provision of electricity and socioeconomic improvements in rural areas through: (i) solar PV, hydro, wind and biomass renewable energy technologies; (ii) credit financing through private participating credit institutions; (iii) grant mechanisms for off-grid systems; (iv) technical assistance for income generation and social service delivery improvements based on villages' access to electricity; and (v) technical assistance to promote energy efficiency, development of carbon trading mechanisms and integration of renewables into government policy, provincial council development strategies and sector reform initiatives.

The program applies a multi-stakeholder approach in overcoming the financial, institutional and market barriers traditionally associated with the implementation of renewable energy options. The Sri Lanka Renewable Energy Program can serve as an excellent model for other initiatives with involvement of multiple renewable energy stakeholders. [Links to PAD and Project Assessment Report]

2. Impact and Results

Business enabling environment: The program has created an enabling environment for private sector participation in grid-connected renewable energy projects by facilitating development of a Small Power Purchase Agreement (SPPA) and by channeling long term credit through licensed commercial Banks and licensed specialized Banks. Private sector participation in off-grid renewable energy development was stimulated by the participation of Micro Finance Institutions (MFIs) in the credit program. In particular, participation of MFIs was instrumental in achieving increased penetration of solar home systems (SHS).

Renewable Energy Industry: The implementation of the private sector led renewable energy program has created a vibrant industry of suppliers, developers, consultants and trainers. By end-2004 there were over 40 mini-hydro companies backed by about 20 active developers, 10 registered solar companies, 22 registered village hydro developers and 12 village hydro equipment suppliers as compared to 1 mini-hydro developer, 2-3 fledgling solar dealers and 1-2 village hydro developers at start of the program. In addition, at the village level, there are more than 80 functioning electricity consumer societies operating under ESD and RERED standards. It is estimated that over the period 1998 – 2004 a mere US$100 – 150 million has been invested in the on-grid and off-grid renewable energy sector.

The collective experience has created a dynamic renewable energy industry with significant local expertise, minimizing the need for expatriate consultants. Having achieved success in the domestic market, Sri Lankan mini-hydro developers are now looking to overseas markets in Asia, Africa and Europe and local renewable energy consultants have began undertaking regional assignments to share their experience.

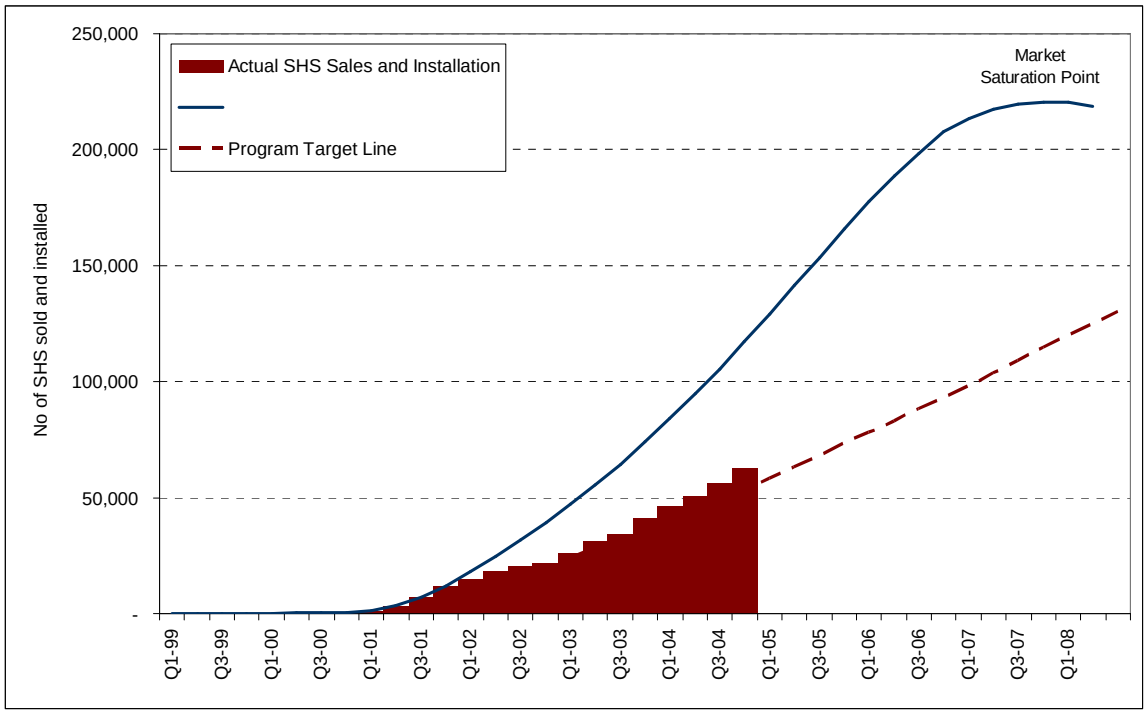
Grid Connected Renewable Energy Systems: The combination of the Standard Power Purchase Agreement and the availability of long-term credit contributed to a rapid increase in mini-hydro installed capacity from about 1 MW in 1997 to nearly 70 MW through 30 sub-projects in 2004. A further 38 projects with a total capacity of 39 MW has been approved by PCIs and are at various stages of completion. Several serious private-sector mini-hydro developers are planning more sub-projects. The costs of development have come down, enabling additional project development. At the start of program costs were estimated at US$ 1,030/kW of installed capacity, at ESD project completion review average costs were reported as US$ 964/kW. One biomass project with a capacity of 1MW has been commissioned. Based on lessons learnt, this project is expected to pilot several more dendro power projects. The ex-post economic analysis conducted after completion of the ESD project shows an ERR for the hydro projects (without carbon benefits) of 26% notwithstanding that CEB's announced avoided cost tariff likely underestimates the actual avoided cost.

A 3 MW demonstration wind farm consisting of five 46-meter towers with 600 kW turbines designed to supply a total annual capacity of about 4.5 GWh was commissioned in March 1999 and certified in May 2000 and has been operating successfully. International bidding resulted in a competitive unit cost of about US$ 1,175/kW. The wind farm is successfully interconnected to the CEB grid and operates at an average capacity factor of 14 percent, which is lower than the projected value of 17 percent. The successful implementation and operation of the wind farm has catalyzed significant interest among private developers looking to develop private power projects. To capitalize on this interest the Government issued a 'Request for Proposals' for a 20 MW wind farm in 2003 however the procurement was canceled for unclear reasons. This incident undermined the trust of the private investors in the sector and most of them reduced project development activities or closed operations altogether. The ex-post economic analysis conducted after completion of the ESD project shows an ERR (with GEF grant) of the pilot wind farm of 4%. (See also http://www.ceb.lk).

Community based Renewable Energy Systems: The program has supported the installation of 810 kW village hydro systems serving 3,800 beneficiary households. A total of 79 systems were implemented by December 31, 2004. A further 38 projects have been approved and are at various stages of completion. By the end of 2004, 22 Developers and 12 Equipment Suppliers have been registered. At ESD completion, the completed project costs show an average of $2,060/kW. This is comparable to the economic capital cost estimated at appraisal of $2,023/kW. The first biomass project with an estimated capacity of 35kW to serve a planned number of 100 households started providing electricity to 40 houses in 2004. The first off-grid wind project, a 1kW plant is under review by the AU. The ex-post economic analysis conducted after completion of the ESD project shows an ERR (with GEF grant) of 24% for the village hydro projects.

Solar Home Systems: The Solar industry was at a nascent stage when the program became effective, with 2-3 small operations selling roughly 20-30 systems/month in 1998. The program has catalyzed the market for SHS and the average annual sales were about 1,500 systems/month in 2004. At the end of 2004, 63,000 systems are sold and installed under the program achieved by 11 companies, 125 rural outlets and more than 2,000 staff. The total estimated annual turn-over for the industry is more than US$10 million. The average total installed system costs at ESD project completion are comparable to the start of the program of about US$ 11/Wp. However, market prices have declined slightly to about US$ 10 /Wp today. The ex-post economic analysis conducted after completion of the ESD project shows an ERR (with GEF grant) of 43% for this SHS component. [See Exhibit 1]

Exhibit 1 Actual SHS Sales and Installation versus Projected Product Life Cycle and Program Targets



3. Core Issues

Long Term Financing for Grid-connected Renewable Systems: The omission of long-term financing to PCIs to match the long payback periods of mini and village hydro projects were impediments to the development of small (< 10 MW) grid connected power projects. Under the program longer term financing became available. The two development banks, by virtue of their in-house capabilities and nature of business, were quick to finance grid-connected mini-hydro projects. They also resorted to syndicating the larger mini hydro loans with other PCIs, which led to the broader acceptance by financial institutions of the viability of mini hydro projects.

Standardized Arrangements for Grid-connected Renewable Systems: The lack of standardized agreements between de small power project developers and the Ceylon Electricity Board (CEB), a state-owned power utility were hindrances to the growth of small power producers. The successful development of Standardized Power Purchase Agreement (SPPA) and a non-negotiable Standardized Power Purchase Tariff (SPPT) with the CEB were crucial for the market entry of private sector small power producers. It led to reduced lead-time and transaction costs to the developer and utility, and also overcame the weak bargaining power of small power producers. However at times, the SPPT ran into trouble. Being administered by a monopolistic purchaser in an environment which does not have an independent regulator, the tariff computation methodology underwent changes and data inputs lost transparency. To resolve the issue an independent consultant acceptable to both the CEB and the Grid-Connected Small Power Developers Association was engaged. The overall cost of preparing this set of regulations was less than US$200,000 and triggered more than US$ 100 million of investments in grid connected renewable energy projects in seven years.

Technical Standards for Village Hydro and SHS: The off-grid industry did not have technical standards to ensure quality, safety and longevity and thus reduce commercial risks. The program introduced technical specifications for off-grid village hydro schemes and SHS. These standards are reviewed from time to time based on experience, and adjust for innovations and market development. GEF grant funds are available to financiers to verify that village hydro schemes and SHS designs meet specifications. Grant funds are also available for investigating unresolved SHS consumer complaints against vendors and seeking appropriate solutions. Not surprisingly, no major customer complaints have surfaced to date. Although such technical standards are welcomed by stakeholders, the SHS component of the Program was held up for a year after credit effectiveness as dealers needed more time to source technically certified products. Testing of local batteries for SHS took even more time and VH specifications on distribution lines also required an upgrade. These examples serve to illustrate some of the myriad issues faced by technologies striving towards large-scale commercialization.

Consumer Awareness and Marketing for Village Hydro and SHS: To address the lack of awareness, the ESD credit program executed a generic promotion campaign on SHS and VH schemes. The promotion targeted end-users, government authorities, community based organizations, MFIs and the general public. It educated end-users on the advantages and limitations of SHS and VH power,

informed them about service and warranty arrangements and about available loan schemes. A variety of communication channels were used, including workshops and demonstrations at villages. SHS dealers participated in such village level workshops to demonstrate their products. In addition, community based organizations participating at such events subsequently served as potential catalysts for village hydro development. Progress of the promotion campaign was reviewed monthly. Consumer acceptance of SHS in Sri Lanka took a leap with the entry of a multinational corporation with a well known brand name, and later when a local government authority (provincial council) lent credibility to this private sector initiative by linking its rural electrification program to the market-based renewable energy program. These two events, coupled with the admission of MFIs into the program may be cited as the critical success factors in the uptake of SHS in Sri Lanka.

Rural Electrification Planning and Industry Participation in Policy Development: The absence of an articulated national policy on renewable energy raises awareness and acceptance issues among policy makers, financiers and potential beneficiaries. The problem becomes worse for off-grid project developers when grid extension plans are rendered unreliable by politicians overriding them through ad hoc decisions. Some have even stifled SHS and village hydro project development by making false promises of grid supply just before elections. Increased awareness of off-grid village hydro and SHS as viable options, reinforced by success stories, is now beginning to enlighten politicians. Two breakthroughs are noteworthy. A provincial council and the ministry for plantation infrastructure recognized that full grid electrification is not financially viable. In response, they included solar and village hydro electrification in their development plans and linked their respective initiatives with the program. They adopted a market-based approach and made use of the technical, financial and marketing infrastructure put in place by the program. In addition they provided a transparent subsidy which when leveraged with the program, improved the sustainability of their respective programs. It is expected that their success will spur other provincial councils to also consider village hydro and SHS technology options as part of the rural energy mix. Furthermore, the program supported the creation of industry associations. Members of the associations are private developers, dealers, NGOs and MFIs who have a proven sales record. The associations' main drivers are commercial interests.

Subsidies: Many energy sector programs, in particular rural electrification programs, are burdened by an entrenched existing system of poorly designed, ineffective subsidies. For the renewable energy program in Sri Lanka no substantial subsidy programs had been adopted which allowed the stakeholders to design a subsidy scheme that would provide explicit and transparent subsidies, with an appropriate exit strategy, that increase affordability/commercial viability while retaining cost-minimization incentives, with disbursements linked to targeted outcomes/outputs, not inputs. The scheme separates grants from debt finance or the opposite of 'soft' loans which bundle them. The notion is that the 'last dollar' should be borrowed on commercial terms. This provides a key incentive to minimize costs since the promoter borrows at relatively high rates, usually prevailing in developing countries, to finance it.

The project provides co-financing grants for village hydro and SHS only disbursed after systems have been installed. These co-financing grants for most of the systems will have been reduced to close to zero at the end of the program. This is particular the case for the solar home systems. At the start of the program all systems would receive a GEF co-financing grant reflecting about 15-20% of the initial cost or a net revenue to the industry of the same percentage. For village hydro systems, one-time GEF subsidy of $400/kW is provided to the cooperatives on a reimbursement basis. For SHS, the dealers receive a GEF grant of approximately US$ 2.3/Wp for a reducing capacity rating (Wp) per system over time. With the increasing commercialization of the industry, the co-financing grant are phased out from the products that reached commercialization while retaining co-financing grants for systems, in particular the smaller systems for poorer households, that were not yet viable. The overall level of GEF subsidy to the industry reduced from the initial 15-20% at the start of the program to 8-12% in 2004 and a planned out phasing of all GEF co-financing grants by 2007. The cycle from inducement of the solar home system industry supported by co-financing grants to full commercialization will have taken 7 to 9 years.

While much of the discussion often revolves around investment subsidies, the program found that non-investment subsidies can often have a catalytic effect. For example, cost-shared business planning is usually critical as well as awareness programs are often critical (see also Financing Mechanisms).

4. Institutional Arrangements

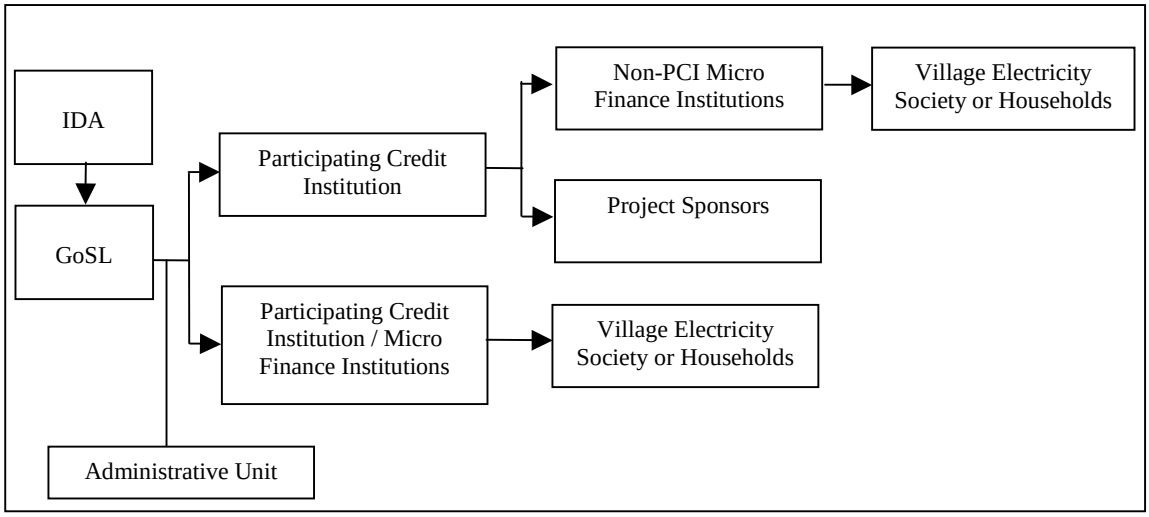
Administrative Unit: The DFCC Bank Administrative Unit (AU) is the implementing agency on behalf of the Ministry of Finance. The AU administers the IDA Credit program to refinance subloans made by Participating Credit Institutions (PCIs) to Investment Projects or subprojects, developed and implemented by the private sector, village communities and NGOs. The AU also administers the GEF grant program to co-finance development of off-grid investment projects, develop new renewable energy applications and technical assistance for an array of activities. The credit program utilizes PCIs which include development banks, commercial banks, two leasing companies and one large micro-finance institution. The PCIs use their standard procedures to appraise and finance subprojects. Eligible subprojects are then refinanced in accordance with the Operating Guidelines.

Operating guidelines: Detailed operating policy guidelines and proposed on-lending arrangements for the credit program have demonstrated to work well with the adequate accountability safeguards. The guidelines define the on-lending mechanism, including the on-lending rate, the terms and conditions, the responsibility of the Administrative Unit, PCIs and other grant/credit receiving organizations, procurement procedures, disbursement procedures, environmental and other safeguards and audit requirements. Eligibility criteria for PCIs, including commercial banks, development finance institutions, merchant banks, leasing companies and micro finance institutions are adopted to enhance the scope of on-lending and new energy applications.

5. Financing Mechanisms

Project Fund Flow: Under the credit facility of the program, the Ministry of Finance and Planning on-lends the proceeds of the credit facility to eligible PCIs, which in turn on-lend these proceeds, along with complementary financing from their own resources, to eligible sub-borrowers. Initially, these included commercial banks, project developers, equipment vendors, electricity cooperatives, and end-users. When the PCI disburses funds against an approved loan amount, it could request a refinance loan of up to 80 percent of the amount disbursed to the beneficiary. [see graph 2]

Exhibit 2 Flow of Funds under the Credit Facility of the Program



Consumer Credit Delivery Mechanisms for SHS: The credit delivery channels for consumer loans for solar home systems (SHS) proved to be different. The program was originally designed for dealers/developers of SHS to provide the marketing, technical support as well as consumer credit. They were to access commercial finance from PCIs for this purpose. Dealers/developers soon realized that micro credit evaluation, delivery and recovery were specialized functions beyond their capabilities. The success of such rural micro credit largely depends on a rural presence, local connections and an understanding of the people themselves. For these same reasons the PCIs too were not equipped to provide consumer credit in such geographically scattered and remote locations. The program turned to MFIs for extending SHS consumer credit. The unbundling of consumer financing to MFIs, who in turn accessed term loans from PCIs, freed the SHS dealers/developers to focus on what they could do best. However, the entry of MFIs introduced another layer in the credit delivery process and pushed up interest rates. This problem was addressed by introducing a new set of eligibility criteria for MFIs to become PCIs and thus access credit line directly. One MFI, which satisfied these criteria, was admitted as a PCI midway through the program. It is presently receiving technical assistance to develop its Solar Financing Division into a successful business unit. Two leasing companies have also joined the program and are financing SHS directly as well as through intermediaries.

GEF Co-financing Grants for Off-grid Systems: GEF co-financing grant funds are made available to off-grid sub-project developers who have signed a sub-loan agreement with a PCI. The grant funds are used to co-finance the initial cost of equipment installed through the program and are available to sub-loan beneficiaries. The co-financing grants are released on a reimbursement basis, after installation of the off-grid system. Broadly, GEF grant funds are targeted to provide transparent subsidies for off-grid VH schemes and SHS to help the service providers develop and expand the market. During project implementation, the subsidies are used to overcome initial cost disadvantages inherent in the technologies and for consultancy services covering off-grid project promotion, project preparation, compliance with technical standards and consumer protection. Such subsidies phases off over time as market volumes increase (also see Subsidy section).

To allow for phasing out of the co-financing grant for the solar industry, the above mentioned subsidy principles were retained while adopting the objectives of the five main stakeholders: building a market around proven systems and ease of administration (DFCC AU); reducing grants over time with a clear exit strategy (GEF); providing incentives to deepen the market and enable access for rural poor (IDA); assuring sustainability of successful product lines and increasing scale (Solar Industry); affording quality and choice at reasonable prices (Consumers). The scheme developed precludes subsidies for already viable solar products, limiting grants as of 2002 only to systems smaller than 60Wp, then only to those smaller than 40Wp during years 2 and 3, and finally only to systems smaller than 20Wp during the last two years of program implementation. This mechanism specifically supports the extension of electricity services to poor people in rural areas. It also promotes sustainability of the market since the subsidy-reduction scheme would, at the end of the program ensure that less than 5% of the turnover of the solar-home system market would be coming from grants. Post-program grant needs would be funded from a rural electrification subsidy mechanism that the Government of Sri Lanka has announced under its recent Rural Electrification Policy.

Grants for Technical Assistance: GEF grants for Technical Assistance are provided through a cost-shared and full-cost window, both operated by the DFCC AU. The cost-shared scheme supports existing renewable energy organizations when proposed projects contribute directly to achieving the objectives of the program's components. It does not include support for hardware and is offered to a company no more than twice. Full cost TA activities require endorsement by a majority of the key stakeholders in the relevant technological areas. The regular stakeholders meetings chaired by the AU provide the decision forum for such activities. The AU, with support of independent experts if required, approves the activities. The TA projects are appraised in accordance with the Operating Guidelines. It finances consultant services to help project developers prepare feasibility studies, business plans, and bank loan documentation. The GEF grant is also available to PCIs to supervise off-grid village hydro and solar home system subprojects.

6. Business Model

The program is private sector led and builds a conducive environment for businesses, entrepreneurs, NGOs, cooperatives, commercial and development banks

and micro finance institutions to provide renewable energy services on a business as usual basis. The Government and the Administrative Unit are market enablers by providing technical assistance for business development services; rule based co-financing grants linked to performance; consumer protective technical specifications; and, introduction of longer term financing to the finance sector on near-commercial terms. The program does not prescribe the market, technologies or products to be offered to the end user and aims to further the creative spirit of local entrepreneurs and rural end-users to provide the sought for electricity services. Regular stakeholders meetings are held and for the different industries the establishment of industry associations is actively supported.

Within this framework several business approaches operate in parallel:

- For stand-alone SHSs, the program is supporting solar dealers that have come forward with business models that sell SHS on a credit basis in partnership with a micro finance organization; lease the SHS through established leasing companies, and over the counter cash sales by independent agents.
- For village hydro systems, the program is supporting communities that have come together to establish electricity cooperative societies, who owns, operates, and maintains the micro-hydro systems to provide electricity services to the end users on a fee for service basis. Tariff is negotiated with community members, and based on their ability to pay.
- For grid-connected mini-hydro, it has supported independent power producers in selling electricity through a standardized power purchase agreement and formula-based tariff to the national utility.

7. Policy and Regulation

Renewable energy policy development: The Government in 2004 with support from the program embarked on the preparation of a policy framework that enables the sustained and rational growth of renewable energy services in Sri Lanka. The preparation of the policy framework respond to the recurring power supply shortages, ongoing sector reforms, 2 million households without electricity and a rapidly growing renewable energy industry. The objective is to develop a national policy framework for renewable resource based electricity generation that addresses: energy policy; regulation; legal issues and commercial issues including tariffs and subsidies. More particular issues that will be addressed are: i) standardized tariff setting methodology for selling of renewable electricity to the national grid including a possible capacity payment for systems with a high plant factor; (ii) integration of renewable energy systems in a reformed sector, in particular the off-grid village hydro systems and the renewable energy systems connected to the distribution grids; (iii) standardized arrangements to ensure optimum and rapid usage/development of hydro, wind and biomass sites; and (iv) legal and regulatory mechanisms to promote renewable energy off-grids such as inset franchising, separate licensing and interface aspects with existing utilities. Also, exit options for stranded assets and mechanisms for awarding concessions in current project areas to other groups such as the private sector or cooperatives. Furthermore, CEB has taken a view that embedded generation capacity should not exceed 15% of its minimum daily demand to maintain power and system stability and integrity. National policy guidance on these issues is limited and the Government has

therefore decided to prepare a National Policy on Renewable Resource Based Electricity Generation.

Standardized Arrangements: As earlier mentioned the program addressed the lack of a Standardized Power Purchase and Tariff Arrangements for small grid-connected power projects. The standardized arrangements reduce lead-time and transaction costs to the developer and utility, and also overcome the weak bargaining power of small power producers. The successful development of Standardized Power Purchase Agreement (SPPA) and a non-negotiable Standardized Power Purchase Tariff (SPPT) with the Ceylon Electricity Board (CEB), a state-owned power utility, were crucial for the market entry of private sector small power producers.

8. Technical

Eligible renewable energy technologies: The market based approach chosen under the program does not prescribe the technology or products used by private developers, NGOs and dealers to provide their renewable energy services. Any renewable energy technology is in principle eligible for support under the program, that is, if the proponent can show through business planning, feasibility study and/or market research that in the medium term there is sufficient turnover to sustain a commercial industry. Grid connected hydro systems, solar home systems and lesser so village hydro systems have proven over the last years that they are either commercial or near commercial existence. These technologies will continue to receive support under the program. Biomass and wind have shown good potential and the program will support these in their early commercialization phases. Other technologies have not yet come forward.

Technical specifications: As mentioned earlier the program guarantees compliance with technical specifications for off-grid village hydro schemes and SHS. These standards are reviewed from time to time based on experience, and adjust for innovations and market development. Although such technical standards are welcomed by stakeholders, the SHS component of the Program was held up for a year after credit effectiveness as dealers needed more time to source technically certified products. Testing of local batteries for SHS took even more time and village hydro specifications on distribution lines also required an upgrade. These examples serve to illustrate some of the myriad issues faced by technologies striving towards large-scale commercialization.

Stranded assets: As the main grid expands, it is likely to encompass some village hydro systems, raising the issue of how to ensure that the Village Electricity Society (VES) remains financially whole. This “stranded asset” issue has been flagged and is addressed in the context of the Rural Electrification Policy as well as the new Electricity Act and Regulations. One solution being considered is for the main grid operator to make a buy-out offer to the VES which is at least sufficient to cover any outstanding loan balance. The VES could also have the option of retaining some or all of its systems, and act as a retail intermediary. The program provides technical assistance to evaluate these options and, in line with eventual findings on the number of installations impacted, assist the Government to reach a feasible alternative.

9. Key Lessons Learned

Improve access to capital: One of the key barriers for private entrepreneurs and households was access to additional capital for energy investments this could be the need for longer term loans that would better fit the cash flow requirements of the grid connected system; to provide financing to allow for more affordable village hydro and solar systems; or the need for working capital to support rapid industry expansion. Tailored design to meet these different financing needs is important. The program provided:

- a near-commercial, long term credit to PCIs for grid connected operations;
- an opportunity of involving the MFIs for off-grid applications. The entry of the MFIs into the program made SHS more affordable and opened new markets for the retailers. It proved that MFIs are more suited for rural energy service provision than commercial banks or SHS vendors;
- output focused GEF co-financing grants to buy down initial capital cost of village hydro and SHS; and
- refinance to PCIs denominated in local currency, with the Government taking the foreign exchange risk on the IDA loan.

Build a business enabling environment: Commitment by the government is very important, and this should be reflected in willingness to ensure consistency among national and sectoral objectives, e.g. making sure renewable energy can compete with other technologies on a level playing field for example through rationalizing import duties on photovoltaic modules, introducing new Rural Electrification Policy, which aims to promote sustainable market-based provision of rural services and finalizing electricity reform legislation, which is expected to reinforce incentives and institutional structures for the continued development of small renewable energy projects. The project supported the preparation of a standardized Small Power Purchase Agreement (SPPA) and a standardized, formula-based way of determining the least cost tariff. The SPPA replaces the cumbersome process of negotiating every small power project on an individual basis. In many cases the negotiation process required substantial input from specialists and lawyers often increasing the bureaucracy and overhead to a level at which the project became unviable. Business associations improve impact, and allow for constituency building for business environment improvement. In total, five associations where established: Small power producers association, solar industry association, village hydro association, village hydro consumers association and biomass association. In this organized fashion, these private electricity providers have become a constituency for private participation in the power sector.

Scale-up capacity building initiatives: The introduction of a new industry coincides with learning of new skills within almost all organizations involved. For the project developers, it is the knowledge of a technology, the closing of a deal with the national utility, and the preparation of a bankable proposal among others. For the financiers, it is the analysis of the risks. For the utility and the end-user it is the quality of the product offered. In the initial stages of the market uptake, the capacity building initiatives were conducted on project by project basis. This took time and is one of the reasons for a slower than anticipated uptake in the village hydro and

solar home system component. With the market growing, the industry started to bundle capacity building efforts including: technical training for hundreds of installers of solar systems through the Solar Industry Association; supporting formal training institutions with integration of curriculum in regular programs; usage of a methodology to identify in a short timeframe key issues and a wholesale agenda for further actions for the industry; a "innovation solicitation" process to stimulate further market growth with the key members of the industry; and, establishment of a framework for wholesale capacity building initiatives. Through these initiatives nearly one thousand employees were trained under the program.

Introduce new systems and technology through market principles: Introduction of new technology in a sector as well as in a company often needs to be driven by sound economic rationale and market principles. For the introduction of the alternative energy systems in Sri Lanka, two fundamental principles were followed: (i) the systems need to be the least-cost option compared to its competitor products (grid connected mini hydro projects); or, (ii) the incremental cost of the systems need to be in-line with the incremental cost globally and have a clear declining path of these costs due to economies of scale (solar home systems and village hydro projects). These principles have contributed to an industry that is expected to grow even after external grant support is withdrawn. The program also introduced reliable after-sales service to ensure project sustainability; efficiency of the delivery chain through the introduction of information technology; and most problems can be avoided if customers are made more aware about proper use and of the limitations of their systems.

Learn the market and its consumers: Initial market surveys and pre-investment studies scoped the market for the new technology systems. These attracted early developers to enter the market. The survey and studies however did not provide any detailed information on the specific need consumers have for the different products. With competition increasing and the expectation of returns, companies have emerged with greater understanding of their clients in their particular market niche. More detailed lessons were identified by the stakeholders during the surveys, especially, including: (i) rural end-users are willing to pay more for their energy expenditures, as long as the energy supply is reliable and safe even if it costs more than what they are used to paying; (ii) investment in market development activities is crucial to the success and sustainability of a renewable energy program. This can take the form of technical assistance directed at enhancing the capacity of the private sector, concerned government agencies, NGOs, etc to first, learn about the technologies and the associated issues, and then how to properly implement and monitor projects; (iii) local or community participation in, and cash contribution for, the implementation and monitoring of off-grid projects is a crucial element to project success as it ensures ownership on part of the communities involved, promotes improvement of local capabilities, strengthening of community relations, and also aids in cost recovery; (iv) middle to upper income rural people benefit most as the technology involved is not cheap, and these are the groups that have the willingness and ability to pay. To financing institutions, they also represent 'sound risk.' Under the program, SHS and village hydro customers typically fall under the middle-income category (on the basis of actual income and expenditures data obtained through the field surveys). More than half are involved in agriculture and have

seasonal incomes. Around 25% hold either government or private sector jobs and earn monthly incomes.

Integrate productive uses at all levels: Under the program, SHS and village hydro customers who were included in the field survey all acknowledged an improvement in their overall well being. They also cited the accrual of economic/financial benefits, but mainly in the form of future savings once their loans are fully paid off. For a rural electrification project to have a direct impact on economic development, the project design should have an integrated approach where specific activities targeted at economic development are incorporated, e.g. improvement of local infrastructure and local capacity-building.

Allow for flexibility in project design: One of the major reasons for the success of the program is that project design was flexible enough to allow different approaches and changes as and when required.

Critical role of the GEF in implementation: This project could not have been implemented without GEF support, especially for catalyzing the SHS and village hydro programs. GEF's initial support will be further leveraged through the program where solar and village hydro programs are being scaled-up. It is also important to note that the subsidy role of the GEF for these two types of subprojects will be reduced over time, so that eventually these subprojects can proceed without such support.

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