Public Private Partnerships for Community Electricity

PACE

Ethiopia, Nepal, Sri Lanka, Uganda

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Overview of the Electricity Sector in Relation to Public Private Partnerships in SRI LANKA

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1 Introduction

1.1 PACE Project Background

Access to affordable, safe electricity is a fundamental step in the transition from a poor community to one showing sustainable economic growth and social development. Energy for productive uses, particularly in the agro-processing sector, is a key driver in improving local economic and social opportunities. Grid extension to rural areas in many countries is happening very slowly and even where the grid is present, in urban or peri-urban areas, many businesses, communal services and households are still unable to access power due to high connection charges or discrimination (e.g., licensing, traditional housing type, tenant status, etc.).

A growing number of communities in many developing countries do not have access to electricity, as traditional monopoly utilities in most of these countries cannot keep up with increasing population growth, and increasing demand for electricity services for businesses, institutions and households. Increasing decentralisation of government to local regions in many countries provides opportunities for these bodies to become involved in supplying electricity services.

The Department for International Development of the United Kingdom (DFID) is funding a four-country programme to review and pilot alternative models for Public Private Partnerships for the delivery of electricity services to communities in developing countries. This report provides an overview of the country situation in Sri Lanka.

1.2 Local Government Structure in Sri Lanka

Sri Lanka has been a parliamentary democracy since independence from Great Britain in 1948. Economic liberalization began in 1977 where the country moved towards a free market economy. The Sri Lankan government has 3 tiers – the federal, provincial and district levels. There is also village level representation from the government. In the last decade there has been a process of decentralization of the government's administration, to move it closer to the population. Given that 75% of the people live in rural areas, this has made life easier for the majority of the people.

With its proximity, the provincial governments are proactive in meeting the needs of grass roots level people. This has been the case in the energy sector. The 13th amendment of the constitution allows the provincial councils to provide energy services to the constituency. Even though there is a need for clarification in the responsibilities between the federal and provincial governments, they have

invested in developing small scale renewable energy projects (micro hydro and solar PV) in partnership with NGOs and the private sector.

With the further deregulation of state entities such as the CEB, there will be a larger role for the provincial and district level governments in the energy and other development sectors.

1.3 Energy Sector Overview

Sri Lanka's annual per capita energy consumption is 4GJ (India's is 9GJ and Nepal's is 1GJ). When compared with India, this figure is small due to the lower level of industrial development in Sri Lanka. Biomass provides 70% of the total energy used, petroleum products account for 25% (mostly for transport) and electricity about 5%.

In the electricity sector, hydro power accounts for 64% of generation (1133 MW large hydro and 650 MW of Thermal). The government owned utility, Ceylon Electricity Board (CEB) generates most of this in their own plants with about 170 MW of private sector generated thermal and mini hydro power added to it. This electricity is purchased by the CEB based on a power purchase agreement.

Under the Electricity Act, the CEB is the only organization that can generate and sell power to consumers. This may change with the power-sector restructuring process that is underway. The power sector comes under the Ministry of Power & Energy. Smaller scale renewable energy programmes come under the purview of the Ministry of Science & Technology.

Over the last 25 years, Sri Lanka has seen many private/public initiatives and partnerships to promote renewable energy. This has catalyzed the successful private sector and non-government organization driven off-grid and grid connected renewable energy developments. The government has played a crucial role in this process, as an introducer of new technologies, a facilitator and most importantly, a funder of projects. The most significant of these is the World Bank and government funded Energy Services Delivery Project (ESD)[1] which was established in 1997 and ends in 2002. This project has funded the development of the commercial solar PV sector marketing systems for individual rural homes, micro (village) hydro mini grids as well as a grid connected mini hydro sector. These initiatives have shown the importance of public-private partnerships in the delivery of energy services, especially to rural areas as well as in the utilization of renewable energy technologies. The ESD project has been a catalyst to bring together the players from private sector, NGOs and the government.

[1] The Energy Services Delivery project was established in 1997 with the Sri Lankan government, World Bank and GEF funds totaling US $ 55 million for the private sector and NGOs to promote off-grid solar PV, micro hydro and grid connected mini hydro projects. The project ends in 2002 and with its success is followed on by the Renewable Energy for Rural Economic Development with US $ 85 million.

However, the role of energy in sustainable livelihoods has not been a focus of attention in many of these developments.

Energy has been looked upon from a quality of life perspective in moving people away from the kerosene lamp and to provide basic services for lighting and entertainment, as a first step.

The paper describes the history of this process.

Table 1: Statistics

Population	19 million
Physical Area	65,610 sq. km.
GNP Per Capita	US $ 1000
Urban/Rural Population Mix	25% Urban /75% Rural
Percentage Electrification of Households	54%
Power Generation Installed Capacity	1,787 MW
Literacy Rate	90%
Annual Rainfall	100 cm (Dry Zone) 500 cms (Wet Zone)
Mean Temperature Over Land	26-28 Degrees Celsius

2 Renewable Energy and Energy Efficiency Developments

A cross-section of institutions is currently involved in the Sri Lankan renewable energy field. The private sector and non-governmental organizations have driven the commercial dissemination process forward over the last decade, especially in off-grid markets utilizing renewable energy technologies. However, none of these initiatives would have gone far without the pivotal role the Sri Lankan government has played over the last twenty-five years, in introducing and promoting renewable energy technologies. Following this, there have been many direct and indirect private/NGO/public partnerships to promote these technologies over the years.

The Sri Lankan government initiated a project in 1975 with the United Nations Environmental Programme (UNEP) to establish the Pattiyapola Rural Energy Demonstration Center. The project was completed in 1979 where technologies such as Solar PV, Wind Power and Biogas worked together to provide electricity to 200 families in the southern province village, Pattiyapola. The CEB managed the project. A few people within the Alternative Energy Unit of the CEB

championed the project. However, there was limited resources and technical support to maintain and operate the project on a long-term basis. Subsequently, this village got the CEB's grid power and the project was closed in 1989. Even though the project met the fate of many such renewable energy demonstrations during this period, it served well to introduce technologies such as solar PV, wind power and biogas to the country.

The Alternative Energy Unit in was established within the CEB with this project in 1979 and it continued with many activities to promote renewables. Some of them were;

- Promotion of solar PV (SHS) systems where 700 SHS were sold from the head office in Colombo from 1982 to 1987
- Installing 300 Biogas plants in rural farms
- Introducing the efficient fuelwood cookstoves programme later successfully commercialized
- Wind energy survey conducted in the southern province coastal area
- Demonstrating renewable energy systems in exhibitions around the country

The private sector and NGO interest in developing these markets further came about as a result of these pioneering efforts from the government.

Three technologies have developed commercially so far and they are;

- solar PV for off-grid individual homes
- micro (village hydro) for off-grid homes through a mini grid
- mini hydro grid connected systems with electricity sold to the CEB through a power purchase agreement
- Efficient cookstoves

2.2 Solar PV Market

Having 700 Solar Home Systems (SHS) installed by the CEB provided a foundation for companies such as Power & Sun (Pvt.) Limited established in 1987 (later known as Solar Power & Light Company Limited and sold to Shell Renewables International in 1999) and later Sunpower Systems Limited to develop this market. Where as Power & Sun took the path of developing a retail market for SHS in rural off-grid areas, Sunpower Systems developed larger scale projects, such as the Pansiyagama[2] 1000 SHS scheme with BP Solar Australia funded by the Australian and Sri Lankan governments. This was the first public/private partnership project in solar PV in Sri Lanka. This project provided the government and the private sector stakeholders valuable lessons on promoting solar PV.

These initiatives encouraged, two non-governmental organizations, one the well-established Sarvodaya Shramadana Sangamaya[3] and the new established Solanka Associates to promote SHS. Three projects were funded with these NGOs by the Solar Electric Light Fund (SELF) - USA and the Rotary Foundation.

Sarvodaya continues to be involved with solar PV by providing micro-credit through their own organization, SEEDS and Solanka has evolved into the commercial company, RESCO Asia Limited (now known as Selco Sri Lanka), a subsidiary of Selco-USA.

The ESD project has attracted others to join the solar PV arena. There are five commercial retailers marketing systems at the moment (Shell Renewables, Selco Sri Lanka, Alpha Thermal, Access Solar, Energy Works). The availability of micro financing has seen a 300% growth in the market from year 2000. All the companies offer financing through partnerships with NGOs such as SEEDS,

[2] The Pansiyagama Solar PV project was controversial, as it was politically motivated. SHS were provided to customers at a subsidized price and no proper system was in place for collection of payments. As with many multi partner projects, coordination between the government agency, National Housing Development Authority, the technology provider and the service provider was poor. As such, the systems had technical problems and the repayments were poor. Many lessons were learned from the project, but it has also been an important project for the solar PV market development process.

[3] Sarvodaya is the largest NGO in Sri Lanka involved in peace, social development, education, healthcare, water and energy areas.

Thrift & Credit Cooperative, the government owned Bank of Ceylon and private financing companies such as Ceylinco Leasing.

Even though the ultimate risk for the credit is borne by the lender, the vendors work closely with them to ensure that the system is serviced properly and operates well during the loan repayment period. Most of the vendors also have a buy back arrangement in case of default, thereby sharing the risk in the spirit of a true partnership.

In 2001, Uva Provincial Council[4], the least electrified province set a precedent in 2001 by re-allocating funds for rural grid extension to subsidize solar PV systems.

The province found it more economical to subsidize solar PV systems in partnership with the private sector rather than funding the CEB to extend the grid. The province offered a subsidy of Rs.10,000 (Pds Sterling 67) to off-grid households to purchase a SHS. The companies signed an agreement with the province to receive these funds once the systems were sold for the subsidized amount and proof of installation was submitted. In most of these sales there was also a NGO involvement to provide micro financing. Therefore, this scheme was a true public-private-NGO partnership. Over 5,000 systems were installed in 6 months in the province under this scheme, until the project ran into difficulties due to limitations in provincial budgetary allocation. Even though the project has stalled at the moment, once the province gets out of its financial difficulties, the project will continue. Other provinces are also looking at this initiative to follow on.

With all these initiatives there is a total of about 25,000 SHS in Sri Lanka.

2.3 Micro Hydro

Intermediate Technology Development Group's (ITDG), Sri Lankan office pioneered the promotion of micro hydro in Sri Lanka from early 1980s. Village hydro as it is now known, provides off-grid electricity to remote communities that have access to a water source.

This model entails complete community involvement from the stage of project conceptualization, development, construction, commissioning to on going administration and management of the project. ITDG developed very simple technology with locally available expertise and material. It uses a commonly available electric motor as the alternator and turbines are simply designed

[4] The provincial councils in Sri Lanka, under the devolution process, has been granted the responsibility to provide energy services to people based on the 13th amendment of the Constitution. This has activated the provinces to participate in the rural electrification process. The provinces are looking at ways outside the traditional grid extension to provide services and one such initiative is the partnership with private sector to provide SHS.

peltons. ITDG also developed communities' capabilities to run the projects through training and social mobilization. Typically, a village would establish an Electricity Consumer Society (ECS) to operate the project.

There are about 120 such projects operating in Sri Lanka. Most of the early projects were financed through philanthropic initiatives. Village Hydro has also benefited from the ESD project with the over 3,000 households being connected from about 40 projects done so far.

These community-based projects have attracted the support of provincial councils[5] also. The Sabaragamuwa and Southern Provincial Councils have complemented the ESD project funds with grants to communities to leverage the ESD loans.

Devolution of power to provinces has given the provincial governments a mandate to electrify rural areas. However, there yet needs to be clear guidelines and policies to demarcate areas of responsibility between the central government's Ceylon Electricity Board and the provincial council energy ministries. Nevertheless, there is private/public partnerships already happening in this area, as there has been a political will to invest in off-grid renewables.

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2.4 Grid Connected Mini Hydro (500 Watts to 5 MW)

The government established a mechanism for the CEB to purchase electricity from private mini hydro developers in 1997. A standard power purchase agreement (SPPA) was created to streamline the process based on a per unit price negotiated on an annual basis. This made it easier for private sector to establish a partnership with the CEB. Even though the first mini hydro project was established before the ESD project in 1997, the SPPA was developed with World Bank assistance. All projects also have to go through the national government environmental clearances administered by the Central Environmental Authority (CEA).

There are 30 MW of grid connected mini hydro projects in place with most of the borrowed funds coming through the ESD project. There is a potential for about another 100 MW of mini hydro projects, mostly in central and southern hilly areas. This is another example of public/private partnership and this trend will increase as the government looks to the private sector to provide more generation capacity to the national grid.

[5] Sabaragamuwa and Southern Provinces have the most village hydro projects. As such, they are funding communities to develop projects in partnership with Community Based Organizations.

2.5 Efficient Cookstoves

In addition to introducing renewable energy technologies, the government also played a key role in promoting "efficient cookstoves" to rural areas.

Over 90% of the rural population yet use fuelwood for cooking. The Ministry of Energy and the CEB initiated the efficient cookstoves programme in the early 1980s. NGOs such as Sarvodaya and IDEA took over the further education and dissemination of information through outreach activities. NGOs also worked with the government to train potters around the country.
Now efficient cookstoves are commonly available around the country at an affordable price. These stoves are known to have contributed significantly to reducing health effects from indoor pollution as well as deforestation.

2.6 Government Ministries and Agencies Promoting Renewable Energy

Currently, energy comes under the purview of the Ministry of Power & Energy. Ministry of Science & Technology has an Alternative Energy Unit that concentrates on research and development of renewables. Biomass is a new area of focus in the ministry. Biomass energy can be used for both off-grid and grid- connected applications.

Currently, the Ministry of Science & Technology is carrying out pilot projects on energy plantations and has established a 35kW gasifier as a demonstration in Colombo. The experimental plantations demonstrate the "fast rotating coppicing" method where only branches are systematically cut to feed the gasifiers. This will also prevent deforestation and in fact, enhance the forest cover in the country as biomass projects develop.

The tea plantation companies are interested in biomass projects, as many have large tracts of marginal land where fuelwood crops can be grown. Biomass energy can be used as co-generation plants to meet electricity and heat requirements of their factories. Excess power can be sold to the CEB, based on a power purchase agreement.

The Energy Forum[6] is developing a proposal for an off-grid pilot project for the Ministry of Environment and Natural Resources and is planning to do a pilot project in partnership with a remote community.

Biomass projects can potentially have an impact on rural poverty where communities could grow and sell fuelwood to power producers. Biomass area will also require private/public partnerships both at the grid connected level where the CEB will purchase the electricity, as well as at the off-grid level where

[6] The Energy Forum is a non-profit information dissemination, advocacy and a networking organization.

the potential involvement of the government provincial and village councils are there.

There is a National Engineering Research and Development Center (NERD) that has played an important role in developing technologies such as biogas and biomass gasification in Sri Lanka on a research level.

NERD also popularized the Prashakti Lighting Systems where they established a network of private battery charging centers around the country and trained them to manufacture a basic 12 Volt DC lamp. It is estimated that there are over 500,000 battery users in Sri Lanka using this system to operate a few lamps and a 12-Volt TV. The battery is taken periodically to the charging center for recharging. The company, Power & Sun (Solar Power & Light Company) used this as a base to develop the SHS market. Most of the new SHS buyers already use this system as a first step towards moving away from kerosene lighting.

2.7 Non-Profit Initiatives to Promote Renewable Energy

The Energy Forum (EF) is a networking organization involved information dissemination, policy advise and advocacy that began as a project of ITDG – Sri Lanka in 1993. The EF consists of people from various backgrounds (private sector, government, utility, NGO, academic) interested or involved in promoting decentralised and renewable energy technologies. The EF evolved over the years to influence policy, create awareness at public and political levels as well as doing demonstration projects with renewable energy technologies. The EF was established as an independent entity in 1998 to continue the role of information dissemination to the public, influence policy makers and act as a catalyst for research in the areas with universities and other institutions.

EF plays a key role in creating private/public partnerships. It has works closely with rural communities assisting them to find solutions to their energy problems through partnerships with the private sector, NGOs and government. The EF is working with the provincial councils at the moment to assist them to establish their role as a facilitator of rural energy services. They are looking at policies, types of partnerships, technologies and financing. The EF is also bringing these activities to the attention of the public at large.

Currently the EF is working to create a Federation of Electricity Consumer Societies who operate the village level micro hydro projects. This will enable the rural communities to forge partnerships with the private sector to provide financing and technologies and the government to provide incentives and other statutory approvals.

3 Private Sector Involvement in Electricity Provision

The previous section gives general information on national renewable energy developments. This section focuses on how the private sector has been involved in electricity provision up until now in Sri Lanka.

Private sector has played a major role in the off-grid energy developments as well as promoting renewable energy in Sri Lanka. In the initial stages the private sector promoters had much resistance from the government utility as well as local politicians as it was perceived as an encroachment to their area of activity. There has also been a general mistrust of private sector business stemming from the socialist mind set of the country's mainstream. Private sector was traditionally deemed as exploiters for financial gain. However, since 1977, as the country turned towards the free market economic policies, there is a better acceptance of the private sector. Now, the government calls the private sector the "engine of growth" and has divested many state owned enterprises.

3.1 Solar PV

Private sector was responsible for the commercial development of the solar PV market in Sri Lanka, since the establishment of Power & Sun (Pvt) Ltd (later known as Solar Power & Light Company Limited) in 1987. Now, a total of about 30,000 solar PV systems, mostly meet domestic lighting needs, but also power water pumping, remote telecommunication and refrigeration systems.

However, the private sector requires to work with government, NGO and CBOs to develop the market so more rural people can benefit from electricity services.

One of the most crucial partnerships is to provide micro financing to consumers. Here, the private sector has joined with a MFI to provide this service. However, currently there is pressure in the system with only one MFI operating. There needs to be more MFI on board in order to service the market potential effectively. This would be possible as solar PV gains the confidence of the public as a reliable and cost effective power source. The government has to play a role to support this process and the role the provincial councils are playing already (Uva province's subsidy programme) is a good example of such an initiative.

3.2 Small Hydro

The village micro hydro programme is mostly community driven with the private sector consulting companies playing a supporting role as project facilitators through the ESD project.

However, the larger grid connected (build own operate - BOO) hydro projects have all been private sector driven. The first project developer, Vidya Silpa took the risk of establishing and constructing the project before a Power Purchase Agreement (PPA) was established in 1997. These pioneers led the way for others to invest (many mainstream investors) in projects to develop a total of 30 MW of capacity. The World Bank also nudged the government to establish the PPA and pay a fair price to encourage the private sector to invest in this area. The CEB-developer partnership has not been easy over the last 5 years. There is always pressure from the developers to increase the price and to also modify the methodology and the formula of the calculation to make it more attractive.The pricing is based on the world oil prices and paid only for electricity generated and there is no capacity charge.

3.2 Thermal Power Plants

The private sector has been called upon to develop thermal power plants for emergency power during the time of the shortages. Load shedding was done for upto 8 hours during some periods for most of the year 2001. These power suppliers negotiated separate agreements with the CEB to supply power.

4. Assessment of PPP models

In the following table, three different project models relevant to Sri Lanka are assessed against indicators. The Concession Model has been excluded in this analysis as it is yet not widespread in the country.

Table 2 - Indicators

INDICATORS	DESCRIPTION		
	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Private sector trust	Private sector has to develop the market by selling systems so they have to win over the trust of consumers and micro financing institution. The government subsidy programme also indicates the trust the Uva Provincial Council has on the technology as well as the private sector to deliver an alternative service to the grid	The village community's trust in the private sector promoter/ facilitator crucial for project development.	Private sector and the Ceylon Electricity Board have to trust each other, one to generate and supply electricity and the utility to purchase and pay for it.
Private sector capacity - technology, finance, management	The vendors have to sell high quality equipment as the market is far away (as well micro financing allows the consumers to spread the risk). The vendors have to have a flat organization to operate at a decentralized level to sell and service systems. MFI/bank partnerships are crucial for financing	The CBOs known as the Electricity Consumer Societies have to develop the capacity to construct, establish, operate and manage (administrative, finance, technical etc.) the micro hydro project.	Private project developers have the capacity to assess sites, develop feasibilities, raise funds, construct project, negotiate with partnership with CEB and operate it.

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Sustainability (temporal, financial, political)	As consumers pay for the system, it is sustainable at that level. The partnerships as there is government involvement are sensitive as they will depend on policies as well as political priorities.	Projects will not get of the ground in the current scenario without upfront assistance for project development (technical, feasibility and bankable proposal development). At the moment the ESD/RERED project technical assistance grants allow for this. The development of the ESC Federation (by the Energy Forum) maybe a solution for the future, as they could provide expertise as well as funding for these.	These projects are sustainable as long as the utility, CEB provides a fare power purchase price for the electricity. This is renewed on an annual basis. The other issues stems from the depletion of water due to changing rainfall and weather patterns.
Domestic access (affordability, reasons for non-connection)	A typical SHS costs about 200 Sterling Pds. As such, only the higher income households can afford a system. Financing expands the market as the cost is spread - substitute expense on kerosene and batteries. In Sri Lanka only about 10% of the unelectrified rural households could afford a system at current prices.	A typical project costs about 800 Sterling Pds per KW and each household could get about 200 Watts of power for about 20 Sterling Pds per month payment. The community will have to also provide “sweat equity” through labour and also provide stones, sand, wood, cement etc as their equity contribution.	N/A

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Service satisfaction, quality	The equipment has to be of very good quality and the vendors have to provide excellent after sales service and user training. As the system is 12 Volt DC, it requires specific appliances, which are not mainstream. The system also has limitations based on the size and the users must learn to manage the system.	The successful project operation depends on how well the ECS is committed to ensuring that discipline is maintained from the beginning. Consumers have to limit the daily usage (about 200-250 W per household) based on the size of the project. There is a requirement for good leadership and teamwork.	The project developer has to interface with the CEB to provide electricity, so there are many checks and balances in the system.
Institutional tariff	n/a	As the Electricity Act yet prohibits private power generation and selling to consumers, the tariff charged is done on the basis of a membership fee.	The tariff is decided on an annual basis depending on avoided costs of generation and is based on world oil prices and availability of hydro resources.
Available services (health, education, water, etc)	All the systems are for domestic lighting and entertainment.	All the systems are for domestic lighting and entertainment as well as some income generation.	n/a
Partnership types (micro-finance, NGOs, other actors)	There is a vendor/MFI/ Provincial council partnership where the council provides the grant	There is a CBO, private sector project facilitator and lender (Bank) partnership. Local government also provides approvals.	There is a private sector developer/utility (CEB) partnership along with a bank if a loan is required.

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Information - where and how	The solar PV vendors advertise using media, demonstrations etc.. The ESD project also had funds to promote renewables and did so islandwide from 1997 to 2002. Energy Forum also has nationwide information dissemination programmes through schools, CBOs and local government.	The initial ITDG developed programmes have been effective demonstration for micro hydro. The ESD project has also promoted this concept through the media as well the Energy Forum.	The developers get information on sites through maps and then visiting them. The tea estate sector has existing, but abandoned sites which are now being developed.
Initiator	Vendors promote to sell systems, so they initiated the original concept of SHS. Consumers also initiate a purchase after they are made aware.	The ITDG initiated the original concept. Now with promotions of the concept, initiation comes from the village communities who have a water source.	The private sector project developers.
Safety	These systems operate on 12 V DC. Therefore, there is a minimal risk in getting electrocuted. However, the battery has to be protected from children and there should also be adequate lightening protection. User training is important in these areas.	These systems generate 220V AC power, so there has to be an adherence to acceptable safety standards in the generation and power distribution areas.	Standards for interconnection requires safety features on both sides (buyers and sellers)

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Financing	There is micro financing available through Sarvodaya-SEEDS who partners with the vendor. Some vendors have a relationship with commercial banks for consumer credit and some have in-house financing. Financing is crucial for marketing SHS due to high up front cost.	Most of the projects before the ESD project have been subsidized by various agencies and individuals (Rotary, bilateral donors, government, provincial councils etc.). ESD funded projects are done commercially where part of the funds come as a loan from a participating credit institution, part equity from the community (sweat equity, materials and cash), the GEF grant of US $ 400 per kW and in some cases a subsidy from the provincial council.	This is done with private capital and ESD project funds obtained through participating credit institutions (commercial banks) by the developers.
Choice of technology	n/a	The choice of technology is based on the resource. Similar projects could be done with diesel generators and biomass gasifiers. However, they do not exist at the moment.	The choice of technology is based on the resource and the cost. Similar projects could be done with biomass gasifiers, wind power and diesel generators.
Choice of Service (grid/other)	The only choice people have is an off-grid option as they have no access to the grid.	The only choice people have is an off-grid option as they have no access to the grid	n/a

	Solar PV (off-grid)	Micro-Hydro (off-grid)	Grid Connected Mini Hydro/Thermal (BOO)
External factors, environmental issues, trends, politics, pressures	As politicians like to keep control of electrification, there is always a danger of upsetting them when selling SHS to a community as they lose control. There are occasions where people have been told that they will never get the grid if they get Solar PV.	As these are community based projects, it is always good to get blessings from political leaders in the area (and give them some credit). There are advantages to the environment as people protect trees upstream to ensure continued supply of water to the project.	In most cases, the immediate community (if they are off-grid) does not benefit from such a project as the electricity is sold directly to the grid. Some developers have extended the grid to surrounding villages as a part their corporate/social responsibility process. These projects also require environmental clearances (Central Environmental Authority) to ensure that no harm is done to the area while building the wier, the channel, penstock and the power house. They will also ensure that no land gets underwater in the process.
Income generation activities	These small systems do not have sufficient capacity to operate machines and motors. The extension of the ay with light enables small businesses to work longer (grocery stores, sewing of clothes, handicrafts etc.)	Much of the energy generated during the day is wasted in these projects. As such the excess power could be used for motive power to operate a rice mill, timber mill etc.. There could also be battery charging for people living outside the project area. The ECS could earn an income to the community with these initiatives.	Area people may gain employment during the construction of the project. To operate the project only about 4 people will be required.
Livelihood impacts (health, education, security, income generation, gender, aspirations etc)	There is a positive impact on the quality of life with an SHS. Improved indoor air quality leading to better respiratory health; opportunities to study at night; security from thieves and elephants; being in touch with the rest of the world through TV and radio and a general “feel good” factor in having lights. Women benefit from having light as they get up early to prepare for the day.	There is a positive impact on the quality of life with an SHS. Improved indoor air quality leading to better respiratory health; opportunities to study at night; security from thieves and elephants; being in touch with the rest of the world through TV and radio and a general “feel good” factor in having lights. Women benefit from having light as they get up early to prepare for the day.	

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Policy issues (approvals, regulation, local/national)	No approvals are required for SHS.	The community has to get approval for the following: land use, use of water, environmental clearance from the local district/divisional secretariat. However, off-grid hydros are not entirely legal as the Electricity Act only allows the CEB to generate and sell electricity to consumers. They operate as an independent cooperative to get around this.	The projects require environmental clearances from the CEA, as well as land and water use clearances from the district/divisional secretariat. The Power purchase Agreement is signed between the CEB and the developer to get the project off the ground. The Chief Electrical Inspector gives the final approval based on safety and other technical/interconnection approvals
Recourse to obstacles, service problems, etc	The vendor provides a warranty for the equipment and service to customers. As there is competition, there is check and balance here (bad news travels fast). When micro financing is provided, it is very important for system to operate well, as customers will not repay the loan otherwise. Here, the vendor and MFI have an agreement to ensure this. The ESD project also has a quality assurance standard attached to the GEF grant. A vendor can access the grant only if they install ESD approved systems (monitored by the ESD-Administration Unit).	For ESD project beneficiaries, there are basic quality and safety standards that are monitored by the ESD-Administration Unit, when the GEF grant is provided. However, older projects face problems of exorbitant service and parts costs from the small number of suppliers. The Energy Forum has catalysed the establishment of a Federation of Electricity Consumer Societies with the cooperation of Sabaragamuwa and Southern Provincial councils. This will give these community based project operators more leverage and recourse.	The Power Purchase Agreement between the CEB and developer has in-built recourse to either party for non-performance. There is also a mechanism to deal with disputes, based on the power purchase price and other compliance related issues.

	Solar PV (off-grid)	**Micro-Hydro (off-grid)**	**Grid Connected Mini Hydro/Thermal (BOO)**
Economic impacts, job creation, new business sectors, revenues for local area	Short-term economic impact to local area is minimal. A business such as a grocery store and small manufacturers may gain from gain from having a longer day with lights. Solar PV could power a local telephone/fax machine and even internet and e mail.	There could be en economic impact to the local area, if the power is used to operate a rice mill or a small factory. Larger projects with capacity of over 75 kW could have such an impact.	Local area will benefit during the construction of a project. If the developer has extended the grid to the immediate area as a donation to the community, this could have a large impact.
Technology dependency, vulnerability, reliability issues, short/long term	Solar PV module is reliable and usually has a 20 year warranty. The battery and 12 Volt lamps are vulnerable and is the weak link of systems. They have to be replaced by the user every two years or so (cost of GBP 30 approximately) On another level communities may risk being overlooked for grid extension when they have SHS. As the wiring for a 12 V DC system is different to AC wiring, if the grid comes they will be redundant.	The biggest source of vulnerability is the available water source. There is trend of more frequent drought which is a cause for concern. The other is that the ECS is alone and could be taken advantage of by maintenance and repair companies. Joining the Federation of ECS's should mitigate this problem.	The biggest source of vulnerability is the available water source. There is trend of more frequent drought which is a cause for concern. Also, if the CEB is restructured or privatized, the status of these developers has not been clarified.

5 Conclusions

As the traditional model of government controlled centralized provision of energy have limitations due to economic and environmental reasons, a new paradigm in energy services is emerging.

In the meantime the government has played an important role of also introducing alternative forms of energy for rural areas. Private sector and NGOs have taken these initiatives to create a new paradigm in energy services, which is decentralized and commercially driven. However, the private sector and NGOs can only service a segment of the population, which can afford services at commercial prices. In Sri Lanka, out of 75% rurally based people, only about 10% could afford these services. Therefore, private/public partnerships are going to be crucial if this segment is to receive energy services. Given the long-term linkages between energy and economic development, government will especially have to participate with the private sector to complement the new initiatives with policies, financing and other enabling mechanisms.

Appendix I - Public Private Partnership Model Types already tested

	Input	1 **Direct subsidy to private entrepreneurs (including subsidy for PV SHS)**	2 **Formation of a private sector company, to own manage the system after its construction by a public body**	3a **ESCO: Independent Utility Producer/Distributer led electrification**	3b **ESCO: Energy Manage-ment and Services**	3c **ESCO: Generator only (IPP) - (public or private ownership)**	4 **Distribution systems leased to Private or NGO-type or community-based organisations**	5 **Isolated grids leased to the private sector (both generation and distribution)**	6 Construction by Private Sector: BOOT, BOT BOO, BBO, DB, DBM, DBO, Turnkey	7 **Concession Model - geographic**
Country Cases		SrLa, Ne, Ug a) Uva Solar; b) UPPPRE	Ne a) Namche MHP; b) Salleri MHP	SrLa, Ug, Ne a) Sabaragamuwa/Southern Prov MHP (40 projects), SrLa; b) Magale hospital diesel, Ug; c)? Uganda lake Vic PV; d) EECMY, Eth; e) SDC, Eth MHP	NA NA	SrLa, Ug, Ne Only selling to grid	Ne a) SBB MHP; b) Tehrathum grid	Eth, Ne a) Gunino diesel, Eth	SrLa, Ne, Ug NA	Ug, SrLa a) LECO (grid extension) SrLa;
Exists? Yes/No	Y/N	Yes		Yes		Yes			Yes	Yes
Number of schemes	Number	8,000 SHS		40 MHP		12 Mini Hydros/10 Heavy Oil Thermal Generators			12 Mini Hydros/6 Heavy Oil Thermal Generators	6 Districts
Total Installed (MW)	Number	0.32 MW		0.6 MW		30 MW - Mini Hydro; 100 MW Thermal			30 MW Mini Hydro/100 MW Thermal	
Years of successful operation	Number	1 Year		4 Years		4 Years			4 Years	15 Years
Financially viable (Y/N)	Y/N	Yes		Yes (with support for project development activities)		Yes			Yes	Yes

Who is served (Govt, inst, priv bus, HH)	G/I/B/HH	HH	HH, B	Govt Utility	Govt Utility	HH
Who is excluded (same categories)	G/I/B/HH	B		HH	HH	
Replicable in-country (Y/N)	Y/N	Yes	Yes	Yes	Yes	Yes
Primary use of electricity	Describe examples	Lighting, TV	Lighting/TV, Rice Mill	Selling to Utility	Selling to utility	Domestic, Commercial & Industrial
Estimated Population served	Number	40,000 people	15,000 people			500,000 people
Initiator (organisation/agency)	Name of agency	Sabaragamuwa Provincial Council, Solar Industries Association	Community Based organizations in the villages	Private sector project developers	Private sector project developers	Lanka Electricity Company (LECO)
Community Buy-in (Y/N)	Y/N	Yes	Yes	No	No	N/A

Appendix II - The Energy Services Delivery Project

One of the significant events in the renewable energy sector was the establishment by the World Bank and Sri Lankan government, the Energy Services Delivery project in 1997 with US $ 55 million.

The ESD Project

In 1997, the Sri Lankan government, the World Bank and the Global Environment Facility (GEF) established the Energy Services Delivery Project (ESD) to finance private sector renewable energy developments. This US $ 55 million fund has financed over 20,000 solar home systems, 3,000 households through micro hydro mini grids (village hydros) and 30 MWs of grid connected mini hydros up to April 2002. The funds are provided commercially through banks for project developers. The off-grid projects have a GEF grant component (i.e. US $ 100 per solar home system or US $ 400 per kW for village hydro) given to the developer.

With ESD project technical assistance funds, the CEB – Pre-Electrification Unit was established to support the private sector in the promoting these renewables, as well as to identify areas where the grid will not reach in the short and medium term. The ESD project is administered by a local development bank, called DFCC Bank. Several private banks called Participating Credit Institutions (PCI) disburse funds to project developers. These are the DFCC Bank, National Development Bank, Hatton National Bank and the Seylan Bank

The project was successfully concluded in July 2002 and the second phase, Renewable Energy for Rural Economic Development (RERED) has been established with about US $ 100 million.

Appendix III - Government Policy Issues Related to Electrification and Energy

Public sector investment in power generation has lagged behind the country's growing demand for electricity, which is about 8% per annum. Government also has to address the large rural population (about 53%) that does not have access to the CEB grid.

The Sri Lankan government strategy has two components to address this area:

(i) Creation of regulatory and policy environment which encourages private investment to supplement public resources
(ii) Improving efficiency of energy services delivery

The Sri Lankan government is in the process of articulating a long-term sector reform strategy and a Policy Paper on Power Sector Reform.

These will be based on a Policy Statement that the Sri Lankan government made back in 1985.

The Policy Statement:

"The increasing cost of oil imports during the last decade has had a severe drain on Sri Lanka's foreign exchange. The demand on fuelwood, which provides more than 50% of the energy requirements, has also been on the increase. The hydroelectric resources that can be developed are also limited in extent and require heavy capital investment. Other forms of new and renewable energy are still at a state that does not yield to extensive commercial use.

In light of the above, the following guidelines are provided to a National Energy Policy Framework for Sri Lanka.

Policy Guidelines:

1. Providing the basic human energy needs.
2. Choosing the optimum mix of energy resources to meet the requirements at a minimum cost to the national economy.
3. Optimization of available energy resources (hydroelectric, biomass, solar, wind and petroleum) to promote socio-economic development.
4. Conserving energy resources and eliminating wasteful consumption in production of energy and use of energy.
5. Developing and managing of forest and no-forest wood fuel resources.
6. Reducing dependence on foreign energy resources and diversifying the sources of energy imports.
7. Adopting a pricing policy that enables the financing of energy sector development.

8. Ensuring continuity of energy supply and price stability.
9. Establishing the capability to develop and manage the energy sector

Current policies in Sri Lanka include the provision of electricity to the entire population and harnessing of locally available resources. On the consumer side, the CEB proposes to electrify 80% of the country by 2005. On the supply side, it is recognized that the government has to create partnerships with the private sector to generate the required energy. The government has established policies to encourage the private sector to develop smaller generation plants using thermal, mini hydro, wind power and biomass.