REDEO
RURAL ELECTRIFICATION
DECENTRALIZED ENERGY OPTIONS

EC-ASEAN Energy Facility
Project Number 24

REPORT FOR ACTIVITY 5

RURAL ELECTRIFICATION PLANNING FRAMEWORKS IN BRAZIL

JUNE 2005

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1. Introduction

1.1 Background

Rural electrification is one of the keys to rural development and is gaining high priority in the developing country to meet the economic, social, political and regional development goals and Brazil is not an exception. Grid-base electricity is more expensive in rural than in urban areas due to lower load densities, lower capacity utilization rates, and often higher energy losses. Rural consumers increase the costs of generation electricity disproportionately, since rural areas add to the evening system peak, when the power is more expensive. Since these cost rises considerably in areas with small loads with low load densities, alternative approaches are necessary in order to meet rural electricity needs in the least expensive way. The Brazilian experience in implementing rural electrification policies and programs, both grid extension and off grid system has been very impressive and can be a lesson to the Cambodia, Lao PDR and Vietnam.

1.2 Objectives

The main objective of this report is to examine the current situation power sectors and rural electrification, and then to analyse the plan of the rural electrification development in Brazil. Special emphasis is given to the decentralized rural electrification planning and policy options. The report also discusses the opportunities of the private sector to participate in rural electrification development. The lessons from analysed countries can be interesting for the design of planning framework in rural electrification in ASEAN countries.

1.3 Scope and Limitation

The study is limited to the case of Brazil and is based on secondary information available in published literature as well as the information available in the official website of the concerned agencies.

1.4 Organization of Report

The first part presents some background information along with the objective and scope of study. The information regarding the power sector, the ongoing reforms and the institutional agencies is dealt in second chapter. In the third chapter, the current status of rural electrification, various policies measure and programs, role of different organizations, financing and delivery mechanism, incentive and tax structure are presented. The fourth chapter presents an analysis regarding Brazil's initiative in implementing rural electrification program that can provide lessons to ASEAN countries specifically, Cambodia, Lao PDR and Vietnam. Finally, the conclusions and recommendations for the design and implementation of a framework to rural electrification in ASEAN countries in presented in the fourth chapter.

2. Overview of Power Sector

2.1 Country Background

Brazil is located in east-central South America and occupies nearly half of the South American continent. The total area covered by Brazil is 8,511,965 square kilometers and is slightly smaller than the United States. The country's topography is quite diverse, combining the Amazon basin in the north and west and the Brazilian Highlands in the southeast. Two of the Brazil's most prominent geographic features are its vast rainforest and the Amazon River.

Brazil is the fifth largest country in the world with the total population of 176.6 million [1]. On average, the country's population density is around 21 inhabitants per square kilometer. Brazil is divided into 27 administrative regions or states.

Brazil is also the 13th largest economy in the world with the GDP of 492.3 billion US$ and per capita GNI of 2720 US$ [1]. The Brazil's economy is highly diversified and has one of the most advanced industrial sectors and sophisticated services industries in Latin America. The country is the world's largest producer of sugar cane, coffee and tropical fruits, and has the world's largest commercial cattle inventory. Brazil's industrial sector accounts for nearly one-third of the country's GDP.

2.2 Power Sector at a Glance

The Brazilian power system is one of the ten largest of the world with a total installed capacity of 86.51 GW. [2]. It is the third larges producer and consumer of electricity in the Western Hemisphere. In 2003, Brazil electricity supply accounts to 402.1 TWh. Hydropower is the major source of electricity and constitutes around 76.1% of the total electricity supply and 90.6% of the installed capacity in 2003 [3]. The major consumer category includes industrial, commercial and residential consumers and in 2003 the electricity consumption accounted for 46.9%, 22.8% and 22.3% respectively. However, due to large regional economic differences and development patterns the electricity per capita consumption is only 2273 kWh [3], below the world average and well below those of the developed countries. A strong plan for electricity development in the country is one of the main tools, which is used by the government to decrease large regional differences. Many of the Brazil's hydropower generating facilities is located far away from the main demand centers, resulting in high transmission and distribution loss, which account for around 15% of the total electricity supply in 2003 [2].

Until recently, the Brazilian power grid was composed of two major interconnected grids, independent of each other, and several isolated small systems (presently served with diesel generators) located in the northern part of the country. The southern, south-eastern and central states formed the larger of the two interconnected systems, responsible for nearly 80% of the country's power generation and consumption. The other interconnected system served the northeastern states plus the northern state of Para. In 1999, the two separate networks were linked, making 98% of the electrical market one vast interconnected system.

2.3 Power Sector Reforms

Until mid 1990s the Brazilian power sector was a State-owned monopoly, where majority of assets were owned by the states, planning and operation was centralized through Eletrobas (the holding company of the sector), and the price was regulated based on sector overall cost of service.

The restructuring of Brazil power sector started in mid 1990s. In 1995, Law 9.074 was adopted that allowed independent power producers (IPPs) and large consumers (more than 10 MW) to buy electricity from the supplier of their choice, including IPPs. In 1996, Law 9.427 created ANEEL (Agencia Nacional de Energia Eletrica), the regulator for the electricity sector. In 1998, the government created an independent system operator (Operador Nacional do Sistema Eletrico, ONS) responsible for the technical coordination of electricity dispatching and for the management of transmission services and a wholesale market (Mercado Atacadista de Energia, MAE) in charge of netting the differences between agreed quantities in bilateral contracts and actual production. In September 2000, a wholesale market was created (Mercado Atacadista de Energia Eletrica), which was put under the jurisdiction of ANEEL in 2002. The generating facilities are mostly under government control and transmission is not slated for privatization in the near term, while distribution is mostly in private hands. Issues related to rural electrification was largely overlooked during the initial restructuring of power sector.

In July 2003, a new model for the country's electricity sector was announced, with goals of ensuring reliable supply, stabilizing prices for consumers, and attracting long-term investment to the sector. This new model came into effect in March 2004. The first major component of the new electricity model was the creation of two energy trading markets: a regulated pool which buys power from generators and shares the costs between distributors under set prices; and a free-market environment where distributors and generators can negotiate their own contracts. The model restored power to the Ministry of Mine and Energy (MME) to plan and tender power generation concessions, a role that the country's independent energy regulatory agency ANEEL (Agencia Nacional de Energia Eletria) previously had been responsible for. Three new bodies were created: the Company for Energy Research (Empresa de Pesquisa Energetica – EPE), the Chamber of Electric Energy Commercialization (Camara de Comercializacao de Energia Eletrica – CCEE), and the Electric Sector Monitoring Committee (Comite de Monitoramento de Setor Electico – CMSE), responsible for overseeing the security of supply in Brazil. All of Brazil's 64 distributors will now buy power at a single price generated from the new pricing formula.

2.4 Institutional Agencies

Various institutional agencies are created by the government of Brazil to operate the electric sector. They are described in short in the following paragraphs;

National Council for Energy Policy (CNPE)

CNPE defines the Brazilian energy policy. Its main responsibility is to ensure the structure and stable supply of electricity utilities.

Ministry of Mines and Energy (MME)

MME is the Brazilian Government agency in charge of the country's energy policies (geology, mineral and energy resources). The agency is responsible for planning, managing and creating energy-related laws, as well as supervising and controlling the execution of policies aimed at the country's energy development.

National Agency of Electric Energy (ANEEL)

ANEEL's chief goal is to regulate and supervise the generation, transmission, distribution and lease of electric energy in Brazil. Its main duties include issuing concessionary contracts and authorizations for the exploration of the country's energy sector, as well as supervising the services rendered, thus ensuring quality and compliance with the rights of electric energy consumers.

National Systems Operators (ONS)

The ONS is a civil and private association, which controls the operations of the electric energy production facilities in the National Interconnected System so as to guarantee the continuity, quality and economy of Brazil's electric power supply.

Energy Research Company (EPE)

The EPE is responsible for planning the expansion of generation and transmission systems based on market planning and studies conducted by energy distributors.

Electric System Monitoring Committee (CMSE)

CMSE's main function is to promote and assess the continuity and safety of electricity supply all over Brazil on a permanent basis.

Electric Power Chamber of Commerce (CCEE)

CCEE is a Brazilian agency in charge of negotiating and managing electric energy contracts. It replaces the former Electric Power Wholesale Market (MAE).

3. Rural Electrification in Brazil

3.1 Rural Electrification Status

At present, more than 12 million people in Brazil do have access to electricity. The data from Brazilian Institute of Statistics that is based on 2000 Census shows that 93 percent of the Brazilian population has access to electric lighting. Table 1 shows the electrification status based on Census 2000. There is large disparity in access to electricity between urban and rural population. Only 69% of the rural population has access to electricity as compared to 99% in case of urban population.

Table 1 Access to electricity of the urban and rural population in 2000

	Permanent private households			Permanent population		
	Total	Urban	Rural	Total	Urban	Rural
Total (million)	44.78	37.37	7.41	168.45	136.98	31.47
With electric lighting	42.33	37.04	5.29	157.46	135.74	21.72
Without electric lighting	2.45	0.33	2.12	10.99	1.24	9.75
Electrification rate (%)	94.5	99	71	93	99	69

Source: Demographic Census, 2000, IBGE

There is also large disparity among the different regions of the country in the access to electricity. Table 2 shows the access to electricity in different regions of Brazil. Large number of households in North and Northeast do not have access to electricity.

Table 2 Access to electricity in different regions of Brazil

Regions	Non-connected private permanent households – December 2002					
	Urban	%	Rural	%	Total	%
Brazil (Total)	774,355	1.9%	1,942,012	24.3%	2,716,368	5.5%
North	78,068	3.5%	464,449	56.1%	542,517	17.6%
Northeast	264,644	2.9%	1,119,783	32.0%	1,384,427	11.1%
Southeast	267,855	1.3%	144,121	7.7%	411,976	1.9%
South	106,499	1.6%	137,283	10.0%	243,782	3.1%
Mid-West	57,290	1.9%	73,375	17.5%	133,666	3.9%

Source: Estimate of MME based on Census 2000 and PNAD 2001, taking into consideration the achievements of Luz-no-Campo Programme

Various decentralized rural electrification initiatives (e.g. *Luz para Todos*, *PRODEEM*) are being launched by the Brazilian government to provide electricity to the isolated and largely un-electrified North and Northeast region of the country.

3.2 Consumer Category and Electricity Tariff

The characteristic of Brazilian electricity tariff structure is that the residential and commercial customers cross-subsidize rural consumers, public lighting, and low income consumers. According to ANEEL, the Brazilian Regulatory Agency for the electric sector, average prices for electricity according to each region and class of consumers are presented in the Table 3 [3]. The table shows residential consumers pay more for electricity than industrial consumers. There is also substantial variation in the price of electricity in different regions of the country. The residential and industrial consumers in North and Northeast are heavily subsidized as compared to other regions.

Table 3 Average Tariffs by Region and Class of Consumption (US$/MWh)

Class of Consumer	North	North-east	South-east	South	Mid-west	Brazil
Residential	90.68	81.83	106.44	101.54	96.87	100.18
Industrial	37.09	38.92	53.81	56.35	61.25	50.78
Commercial	80.68	84.27	90.11	87.14	91.28	88.33
Rural	63.85	52.29	61.47	53.98	58.97	57.14
Public Authorities	89.67	90.89	91.51	93.09	96.34	91.91
Public Lighting	54.30	51.91	57.23	52.03	52.79	54.68
Public Service	56.83	51.03	53.27	56.97	54.16	53.51
Self Consumption	87.79	90.81	43.10	48.07	103.95	52.99
Total Average Tariff	64.32	60.65	77.11	73.18	80.65	73.09

Source: ANEEL, Tariff as of December 2004 converted to US$ (1 US$ = 2.7 R$)

3.3 Rural Electrification Programs

The Brazilian government has introduced various programs at both federal and state level to promote rural electrification, including the use of decentralized renewable energy applications. The federal government supports two major programs: *Luz no Campo* managed by Eletrobras and PRODEEM managed by MME. In addition there are rural electrification activities under several non-sectoral and decentralized initiatives such as those of the Ministry of Agriculture, the Northeast Development Bank, and the World Bank Poverty Alleviation Program, which has also been active in the northeastern region.

3.3.1 *Luz – no – Campo* (Light in the Countryside)

This federal program, with financial and technical support from Eletrobras, is Brazil's largest rural electrification effort. The goal of the program is to make electricity available to one million households, benefiting nearly five million population between 1999 and 2002 exclusively through grid extension. This program was in response to the stalled rural electrification process after the restructuring of the power sector.

As of February 2003, 554,628 connections had been made, and another 80,708 were in progress. An additional 252,983 new customers have signed contracts, but have not yet been connected. Only 2,000 off-grid connections were made under the program, from a total of 9,000 planned by the *Companhia Eletrica do Estado da Bahia* (COELBA), as required by the state of Bahia. This may be because of the relative low cost of grid extensions, averaging about US$ 950 per connection [4].

There are no incentives program in the *Luz no Campo* program to create low-cost grid connections or off-grid projects except in two projects in Minas Gerais and Amazonas. Under the program, the rural consumers are expected to pay the full costs of the connection, which are spread over a number of years. A line of credit is available to assist concessionaries and permissionaires. Eletrobas lends 75% of

the investment to concessionaries on easy terms – a 6% rate of interest, two-year grace period, and a five to ten year repayment period. Approximately R$ 2 billion funding is to be made available for Eletrobas from reserves (the so-called *Reserva Global de Reversao – RGR).* In certain states, *Luz no Campo* is also financing the internal installation of households, going beyond the simple connection and installation of the meter.

In 1996, Law 9.427 decreed that 50% of the resources of RGR should be directed to the North, North-east, and Mid-west regions. Half of these resources were supposed to be allocated to programs for rural electrification and energy efficiency for low-income users. In the same year, further law make concessionaires responsible for the cost of providing services to new consumers. Consumers would only have to meet tariffs.

3.3.2 *Luz para Todos* (Light for All)

The *Luz para Todos* (Light for All) program was launched by Brazilian government in November 2003 to supply electricity throughout Brazil to the remaining 12 million people who are deprived from access to electricity. The program targets to fulfill its objective by 2008. This program will be implemented through partnerships between the federal government, the state governments and the concessionaires.

Luz para Todas considers three different alternatives for supplying electricity:

- Grid expansion
- Distributed generating system with isolated network (for small community)
- Individual (household) generation

The total project cost is estimated to be around US$ 2.6 billion. The fund will be generated partly from the concession fees and fines paid by the energy supply companies and collected by ANEEL, as well as from the CDE (Conta de Desenvolvimento Energetico), a fund which is paid into by all electricity consumers. The rest is to be contributed by the federal states and the actors in the electricity market. Electricity consumers do not have to pay for any network expansion.

The concept is to create a new model of supply, and considers the utilization of renewable sources especially to isolated communities. The transition from conventional hydro and fossil fuels sources to renewable is very attractive, especially because the majority of the poor, rural population lives in the North and North-east, where there is abundant biomass and solar resources and can be viable options.

3.3.3 PRODEEM

PRODEEM (Energy Development of States and Municipalities Program) is the main government sponsored off-grid rural electrification program. The principle objective of the program is to promote the supply of energy to poor rural communities that are far away from conventional electric systems. The program

allows the utilization of any energy sources. However, for the most part photovoltaic systems were bought and installed for power generation, public lighting and water pumping. The program is sponsored by international donors and is implemented mainly through Brazilian utilities.

PRODEEM is coordinated by the National Energy Development Department (DNDE), of the Brazilian Ministry of Mines and Energy (MME). The CEPEL – Electric Power Research Center, which is a Federal Company, is responsible for the technical guidelines for projects, comprising equipment specification for the bidding, project evaluation, technical personal training, installation standards, installation verification, performance and failure analysis.

PRODEEM is mainly based on PV systems and since May 1996 CEPEL and MME have already carried out six International Bidding for acquisition of the necessary equipment, known as Phase I, II, III, IV and V, respectively, and a special phase named Pump. Three types of stand-alone systems have been considered in PRODEEM: PV electric energy generation systems, PV water pumping systems and PV public lighting systems.

Table 4 Installation of PV systems in different phases under PRODEEM

Phase		I	II	III	Pump	IV	V	Total
PV electric energy systems	Qty	190	387	677	X	1660	3000	5914
	kW_p	87	200	419	X	972	2172	3850
PV water pumping systems	Qty	54	179	176	800	1240	X	2449
	kW_p	78	211	135	235	696	X	1355
PV public lighting systems	Qty	137	242	X	X	X	X	379
	kW_p	7.5	17	X	X	X	X	24.5
Total	Qty							8742
	kW_p							5209.5

The amount of PV power already involved in the six phases of PRODEEM now comprises about 5.2 MW_p, with over 8,700 PV systems. The systems are installed throughout all the 26 Brazilian Federal States, but especially in the Northeast and North (Amazon) regions of the country.

PRODEEM is a centralized project and uses a top-down approach to identify sites and install equipment. One of the difficulties faced by the project is identifying suitable locations for the equipment purchased in bulk. Under this program, the central government procured photovoltaic panels that were then allocated free of charge to municipalities upon demand. Rather than electrifying individual households, the program focuses on schools, health facilities, and other community installations.

PRODEEM is one of the largest PV based rural electrification programs in the developing countries in the world and the experience from this program will be useful to other international institutions running similar PV programs around the world.

A survey carried out in 43 villages in ten states to evaluate the first phase of PRODEEM shows that only 44 out of the 79 systems (56%) were actually operating [4]. The main problems with PRODEEM include the following:

- A top-down approach, with occasional installations in unprepared and unorganized community;
- No cost recovery schemes, with results in unsustainable service and a lack of funds for maintenance;
- Lack of responsibility of local communities and states for the equipment; and
- Occasional lack of coordination with grid expansion programs; and
- Difficulties in identifying suitable locations for equipment purchased in bulk;

3.3.4 PCH – COM

The Small Hydro Power Development and Commercialization Program (PCH-COM) was launched by Eletrobras on February 2, 2001 in partnership with BNDES. The objective of the program is to encourage grid-connected small-scale hydropower generation by guaranteeing the purchase of the power generated and by offering financing for the enterprises. The goal of the program is to select up to 1,200 MW over the three year period (2001 – 2003), in blocks of 400 MW per year. The main incentives offered by PCH-COM are:

- Possibility of immediate commercialization of the energy produced by SHP;
- Cost reduction due to Eletrobras acting as representative of the enterprise in the Wholesale Power market (MAE);
- Participation in the allotment of PCH-COM fund surplus;
- Technical support from Eletrobras for installation, operation and maintenance.
- Option of withdrawal from program and commercialization of own energy.

The main concern of most entrepreneurs is the relatively low energy purchase price set for the program of R$ 67/MWh. At that price, most of the projects become unattractive. Another difficulty is obtaining collateral.

3.3.5 PROEOLICA

PROEOLICA is the emergency wind power development program created by the Energy Crisis Management Council, through the resolution no. 24 of July 25, 2001. The goal of the program is to install up to 1,050 MW of wind energy by December 2003 and integrating that power into the national interconnected grid.

The goal is backed by the guarantee of wind energy purchases by the state-run Eletrobras over the next 15 years. The resolution also provides incentive mechanisms that favors those projects that go online the soonest.

The cost related to the energy bought by Eletrobras must be integrally transferred to the interconnected distribution system concessionaires, in a compulsory way, in the proportionality of its markets related to the year before.

The Ministry of Mines and Energy is responsible for promoting, coordinating and implementing the PROEOLICA program.

3.3.6 PROINFA

PROINFA (Alternative Sources of Energy Incentive Programme) is a program created through the law 10.438 on April 26, 2002 and was later revised by the law 10.762 of November 11, 2003. In two phases, this law provides for the purchase of electricity from plant operators that use renewable energy sources and supply the electricity generated to the interconnected grid. The main objective of the program is to diversify the Brazilian energy supply mix by increasing the share of renewable energy sources (wind, small hydro and biomass) by means of economic exploitation of the available resources and the applicable technologies. Under the program, a financial mechanism was created to assure that all energy generated is purchased by Eletrobras. In the first phase 1,100 MW each of wind power plants, small hydroelectric power systems and biomass power stations are to start operation and supply electricity to the interconnected grid at defined price rates that have been agreed with Eletrobras for a period of 20 years. The prices determined by the Ministry of Mines and Energy must satisfy certain minimum rates that are oriented to the average electricity tariffs for final consumers: at least 90% for wind energy, at least 70% for small hydroelectric power, and at least 50% for biomass. The prices are limited by maximum ceiling values resulting from the uniform spread of the additional costs among all electricity consumers. Consumers with very low consumption (up to 80 kWh/month) will be exempted from all additional costs.

At the end of March 2004 the price tariffs were published for plants that will enter service in the course of 2006 [5].

Table 5 Remuneration rates within the framework of PROINFA, March 2004

Type	Source	Feed-in-tariff (US$/MWh)	Lower Limit US$/MWh
Biomass	Landfill gas	62.62	30.96
	Rice husk	38.22	30.96
	Wood	37.54	30.96
	Sugarcane bagasse	34.73	30.96
Wind		66.73	55.76
		75.69*	55.76*
Hydro	Small Hydro	43.34	43.34

Source: MME, Converted to US$ (1 US$ = 2.7 R$)

* The remuneration rate for wind energy is dimensioned according to the ratio between the potential yields and a reference yield determined by an ANEEL resolution.

During the first phase, Eletrobras is to sign contracts for the implementation of 3,300 MW (1,100 MW each from wind, small hydro and biomass resources) for the duration of 20 years. In the second phase, the contribution of these renewable energy resources is to increase, supplying 10% of the nation's annual electricity consumption within 20 years. A special status is granted to those operators that work with plant manufacturers who supply at least 60% (in the second phase 90%) of nationally produced components. The program considers the integration of all market agents; the investors, designers, and suppliers to become a success. The National Development Bank BNDES will provide low-interest credits for PROINFA projects on the basis of hydropower and wind energy up to the end of 2005 and for a maximum of ten years.

In the second phase of PROINFA that is scheduled to start after the target of 3,300 MW is reached, further projects are to be realized in order to ensure that renewable energies (excluding large-scale hydropower) account for a share of 10% of annual electricity demand within a period of twenty years. At least 15% of the annual growth in electricity generation should originate from these sources.

3.3.7 Universal Electricity Access

Through the Law 10.438/2002, the Brazilian government has put forward its plan for universal electrification. The law allows ANEEL to play a regulatory role and to set targets to achieve the goal of universal access to electricity. In April 2003, ANEEL issued the Resolution no. 223 which established the general conditions for the elaboration of universal access plans and the responsibilities of distribution concessionaires and permission holders. The Resolution states that consumers will no longer be charged for grid connection expenses, which was the major bottleneck for universal electricity access. This requires an estimated investment of US$ 7 to US$ 9 billion, which will be the responsibility of the utilities, but the Government of Brazil will make available resources from the Energy Development Account (CDE).

According to the ANEEL resolution, universal access much be reached by each concession area according to its rate of electrification, as estimated by the 2000 Census. Table 6 presents the deadlines for the concession areas based on those rates of electrification. In addition to deadlines established for concession areas, concessionaries should meet deadlines at the level of each municipality, once again using the rate of electrification in 2000 as a baseline. Table 7 presents the deadlines for each municipality.

Table 6 Targets for Reaching Universal Access by Concession Areas

Current coverage level in the area serviced by the utility	Target year for universal access
Coverage > 99.5%	2006
98% < Coverage <= 99.5%	2008
96% < Coverage <= 98%	2010
80% < Coverage <= 96%	2013
Coverage <= 80%	2015

Table 7 Targets for Reaching Universal Access by Municipality

Current coverage level in the municipality	Target year for universal access
Coverage > 96%	2004
90% < Coverage <= 96%	2006
83% < Coverage <= 90%	2008
75% < Coverage <= 83%	2010
65% < Coverage <= 75%	2012
53% < Coverage <= 65%	2014
Coverage <=53%	2015

3.4 Key Players Involved in Rural Electrification

There are large number of organizations currently involved in the development of rural electrification and renewable energy in Brazil. These include government academia, non profit organization and the private sector.

Public sector

Public sector organization that involved in rural electrification includes:

- Ministry of Mines and Energy (MME)
- Ministry of Environment Water Resources and the Amazon (MMA)
- National Electric Power Regulatory Agency (ANEEL)
- National Council for Energy Policy (CNPE)
- Concessionaires and permissionaires
- Cooperatives

Non profit entities

Various non profit entities involved in promotion of renewable energy and rural electrification includes:

Reference Centers – CERPCH, CRESESB/CEPEL, GREENSOLAR and CENBIO are the references centers for Small Hydro, Solar and Wind, Solar Thermal and the Biomass respectively. These organizations promotes the development of renewable energy by disseminating information, fostering dialogue between those involved in renewable energy, and supporting studies and projects.

RENOVE – National Network of Civil Society Organizations for Renewable Energy (RENOVE) is a network of NGO's working primarily on rural and/or environmental protection areas. RENOVE supports the commercialization of renewable energy technology through capacity building for energy policy decision-makers, technical assistance for local installations, pre-investment financing, small demonstration projects, and promotion of development models that rely on private/public partnerships.

NGOs – Eco-Engenho Institute has established programs to finance solar home systems and install community systems. APAEB is an association of small farmers and operate a credit cooperative and a revolving fund for financing solar home systems and electric fences. IDER designs, installs, and maintains renewable energy projects. It collaborates with Solar Electric Light Fund (SELF) and manages a revolving fund for solar home systems. IDEAAS is a NGO located in Rio Grande do Sul State that has installed hundreds of solar home systems in rural areas of Brazilian's southern region. Winrock International focuses on rural development, including renewable energy.

Private sector

The private sector includes manufacturers, dealers and installers. They are represented by the industry associations.

ABEER – Brazilian Association of Renewable Energy Companies (ABEER) is the association of photovoltaic companies doing business in Brazil.

APMPE – Brazilian Association of Small and Medium-Size Electric Power Producers is an association of companies that are involved primarily in the small hydropower sector.

3.5 Policy Framework for Rural Electrification

Table 8 summarizes the various policy initiatives taken during the last two decade to promote rural electrification programs.

Table 8 Policy Framework for Rural Electrification

Legislation	Focus	Date
Brazilian Constitution	Considers the distribution of energy to be an essential public service for which the federal government assumes full responsibility, either directly or through designated concessionaires or 'permissionaires'.	1988
Law 8171	This law known as Agricultural Law, established rural electrification policy as a government responsibility. It further stated that the government should crate incentives for rural electrification.	1991
Law 8490	Gave Ministry of Agriculture the responsibility for rural electrification issues.	1992
Law 8631	Assure financing for grid expansion and rural electrification program through RGR; a fund managed by Eletrobras, with compulsory contribution by all concessionaires. These contributions are included in tariffs imposed by concessionaires.	March 4, 1993
Law 8987	This law deals with concessions and permissions but did not address the rural electrification issue	1995
Law 9074	This law established rules for awarding of concession and permission and for regulating extensions of the existing ones. The law recognized the existence of the rural electrification cooperative. This law also allows rural cooperative to become permissionaires when they provide service to any type of consumers in their service areas.	1995

Law 9427	This law mandated that concessionaires and premissionaires be responsible for the total cost of providing service to any new consumer. At the same time the consumer are only required to pay the tariff. This law also decreed that 50% of the RGR should be directed to the Northern, Northeastern and mid-western regions and the rest of the other 50% should be allocated to programs for rural electrification, energy efficiency, and electrical power for low-income users.	1996
Law 9478	This law aim to identify the most suitable solution for supplying electricity to the different regions of the country. This law also established "National Energy Policy Council (CNPE)"	1997
ANEEL Resolution 333	Establishes rules to distinguish permissionaires, which provide public service, from authorization holders, which provides service for private use.	1999
Law 10438	Establishes rules for strengthening of universal service obligation of distribution concessionaires. Provides a definition of the low-income consumer with monthly consumption of up to 80 kWh, plus a second group with consumption up to 220 kWh under special conditions to be defined by ANEEL Establishment of CDE to promote universal access and generation of electricity from renewable sources of energy. An extension of RGR until end of 2010 to assure resources for the continuation of the *Luz-no-compo* program.	2002
Decree 4336	This decree has authorized the use of RGR resources to be lent to concessionaires to cover their losses due to their introduction of the subsidies for lifeline tariffs to low-income consumer.	2002
Decree 4541	Established rules for the use of CDE	2002

3.6 Policy Framework for Renewable Energy Development

Table 9 summarizes the various policy initiatives to promote renewable energy technologies taken in recent years.

Table 9 Policy Framework for Renewable Energy Development

Legislation	Focus	Date/Status
Law 10.762	Specified that transmission and distribution tariffs may not exceed 50% of the prices normally allotted for hydropower plants up to 1 MW and for wind energy and biomass plants up to 30 MW	Nov 11, 2003
ANEEL Resolution 219	Specified that the transmission and distribution tariffs may not exceed 50% of the prices normally allotted if hydropower, biomass or wind energy is used in power units between 1 and 30 MW.	April 23, 2003
ANEEL Resolution 784	Revises previous Resolution 245. Incentives are substantially increased. Up to 75% of the investment can be paid in monthly installments to generating companies, calculated by the formula defined in resolution.	December 2002
Law 10438	Creates the PROINFA incentive program for renewable energy and the Energy Development Account, allows ANEEL to auction certain electric utility concession areas to permissionaires, and covers selected issues on Universal Electrification	April 26,2002
ANEEL Resolution 488	Revises ANEEL Resolution 233. Defines a form to review General Index of Prices, fuels and currency exchange rate variation, monthly, base on reference value defined for January 2001.	2002

Replacement Bill no 2.905/00	Deals with alternative sources in the energy matrix, universal electrification, prolongation of CCCD, the Energy Development Account and other topics.	This bill evolved into Law 10.438
GCE Resolution no. 26	Created the Technical Committee for Efficient Energy Use, whose aim is to propose measures for the conservation and wise use of electric power.	July 10, 2001
GCE Resolution no. 24	Created the PROEOLICA emergency wind power program, with the goal of installing up to 1,050 MW of wind energy by December 2003 and integrating that power into the national interconnected grid.	July 5, 2001
Provisional Measure no. 2.152-2	National electric energy rationing plan applied to all sectors: residential, commercial, industrial and governmental, and from June 2001 to march 1 2002; succeeded in reducing the power consumption by approximately 20%.	June 2001
Decree no. 3.827	Reduced the Manufactured Goods Tax (IPI) to zero for some photovoltaic and wind power system equipment and components until December 31, 2002.	May 31, 2001
ANEEL Resolution 22	Defined new bases of calculation and maximum values for specifying electricity tariffs by distribution companies. This includes special 'normative value' that can be passed on as boundary values to consumers for additionally purchased renewable energies.	2001
ANEEL Resolution 21	Defines minimum efficiencies to qualify cogeneration plants for operation, differentiating by capacity and source. In general, power plants running on renewable energy fuels have a minimum efficiency requirement 10% lower than plants using 25% or more fossil fuel.	January 20, 2000
ANEEL Resolution 371	Regulates the contracting and commercialization of the reserve capacity or self-producers and IPP to supply in full or partially the group of consumers connected to the grid during blackouts or brownouts. Contracts must be for a minimum period of one year and each generating system limited to 30 MW maximum capacity.	December 29, 1999
ANEEL Resolution 261	Requires that concessionaries invest 1% of their annual operational income in research and development and electric energy conservation, which can include renewable energy technologies	September 3, 1999
ANEEL Resolution 245	Established conditions under which renewable energy technologies can access the same subsidies given to fossil fuels, through CCC mechanism, when those technologies are replacing fossil fuels in isolated systems.	August 11, 1999
ANEEL Resolution 233	Creates special incentives for renewable energy technologies. Establish different price caps on electricity generated from different sources to be passed on to consumer tariff. Entrepreneurs are required to define three factors; General Index of Price (IGP-M), fuels, and currency exchange rate variation, to enjoy future adjustments.	1999
MME Portaria 227	The Ministry of Mines and Energy determined that Eletrobras would lead a public call fro the identification of the excess power available for purchase from cogeneration, as well as established the mechanisms for its commercialization.	July 2, 1999
ANEEL Resolution 112	Defines criteria for obtaining registration or authorization for installation, expansion or resizing of thermoelectric, wind, photovoltaic and other alternative energy systems selling power.	May 18, 1999
ANEEL Resolution 395	Establishes procedures for registration and approval of small hydropower plants studies and designs; authorization for SHP plants and communication of micro and mini hydropower (up to 1000 kW).	December 4, 1998

ANEEL Resolution 394	Defines small hydroelectric power plants as greater than 1000 kW and less than or equal to 30,000 kW, with a reservoir area less than or equal to 3 km^2.	Enacted may 28, 1998
Law 9.648/98	Changes devices of several previous laws and authorizes the Executive Power to promote the restructuring of Eletrobras S.A. and its subsidiaries.	Enacted may 28, 1998
Decree 2003	Defines Independent Power Producer (IPP), differentiated from Self-producer and guarantees for both unrestricted access to transmission and distribution systems through identification of the transportation cost involved, calculated by the regulating agency.	September 19, 1996

3.7 Incentives for Renewable Energy Technologies

Small Hydropower

Various incentives have been used to stimulate the construction of new small hydropower plants in recent years:

- At most 50% of the normal tariffs are to be paid for electricity transmission and distribution, whereby a discount of as much as 100% was granted for small hydropower plants that went into operation up to the end of 2003;
- Exemption from compensation payments for flooded areas and from tax payments for water use;
- Possibility for immediate sale to consumers whose demand is greater or equal to 500 kW for interconnected plants and 50 kW for isolated ones;
- Installation of small hydropower requires only authorization by ANEEL, as opposed to hydropower plants above 30 MW, which must go through a bidding process.
- Use of resources proceeding from the Fuel Consumption Account (CCC) in the case of substitution of isolated thermoelectric generation.

Solar Photovoltaic, Wind and Biomass

The incentives for the promotion of solar photovoltaic, wind and biomass includes:

- Solar photovoltaic generators of capacity less than 750 W and unassembled solar cells are exempted from IPI and ICMS tax.
- Wind generators and windmills for water pumping are exempted from IPI and ICMS tax.
- With the enforcement of law 10.438 in 2002, wind and biomass plant also receives benefits of 50% reduction on wheeling fees and direct sale to consumers over 500 kW

3.8 Delivery Mechanism for Renewable Energy Technology

Photovoltaic Systems

Apart from the regulated program like PRODEEM (government sponsored off-grid rural electrification program) and the World Bank Poverty Alleviation Program, a small portion of the remote rural market is already being supplied by means of

renewable energy technologies typically implemented by NGOs. Program for dissemination of photovoltaic system includes following:

- The Instituto Eco-Engenho (IEE), an NGO based in Maceio, in the State of Alagoas, has established with Northeast Development Bank, the *Luz do Sol* program, which provides a credit line to finance small entrepreneurs who develop solar home system businesses in small villages. The user has to pay service fee to the entrepreneurs. Around 2,700 systems have been installed under the program by 90 micro-entrepreneurs.
- The Associacao dos Pequenos Agricultores do Estado da Bahia (Association of Small Agriculturalists of Bahia State, APAEB) is an association of small farmers concerned with industrialization and diversification of the sisal crop. It has established a credit cooperative and runs a revolving fund that replicates the use of photovoltaic systems for domestic use (five-year loan, one-year grace period and no interest), and electric fences (eight-year load, one-to two-year grace period and no interest) indexed to the price of goat meat. It also transfers Northeast Development Bank credit lines to its members to finance PV panels. APAEB has financed or sold more than 500 PV systems.
- The Instituto de Desenvolvimento Sustentavel e Energias Renovave (Institute for Sustainable Development and Renewable Energies, IDER) is an NGO that designs, installs, and maintains renewable energy technologies. It cooperates with the U.S. Solar Electric Lighting Fund (SELF), and supports local associations with revolving funds for replication of PV lighting systems. The scheme involves a down payment and a monthly payment.
- Instituto para o Desenvolvimento de Energias ALternativas e a Auto Sustenabilidade (IDEAAS) is an NGO based in Rio Grande do Sul. It has been implementing some projects to demonstrate the economic, financial, and technical viability of photovoltaic solar energy to bring electricity to isolated rural communities (often low-income) or those located in large voids of electricity distribution in Brazil.

Some pilot projects are being installed by concessionaires or PV distributors in partnership with NGOs or universities or managed directly by the concessionaires. Among them are the pilot projects sponsored by El Paso, in Rio de Janeiro, and BP Solar in Bahia, Ceara and Amapa.

There is also retail market for PV, which according to ABEER, has been estimated to about 3 MW_p per year. These retailers provide equipment to the high-income rural market on a cash-basis or short-term financing schemes in addition to the association market under the Poverty Alleviation Program.

Other Renewable Energy Technologies

According to PRODEEM comprehensive survey regarding decentralized renewable energy initiatives, more than 100 programs and projects, excluding PRODEEM initiatives were identified. Of these projects, 32 have other technologies beyond PV systems, including micro-hydro, biomass, wind and hybrid systems. Most of them are pilot initiatives operated by local associations and supported by universities, research centers and NGOs.

3.9 Financing Mechanism for Rural Electrification

The government of Brazil has created various funds to make possible the financing of the rural electrification projects.

Reversion Global Reserve (RGR) Fund

The RGR is a fund managed by Eletrobras, with compulsory contribution in the form of tax, by all concessionaries. These contributions in turn are included in the tariffs imposed by concessionaires. Law 8631 (1993) and subsequent Decree 774 make provision for financing of rural electrification program through RGR. In 1996, Law 9427 also decreed that 50 percent of the resources of RGR should be directed to the north, northeast, and Midwest regions and that 50 percent of such resources should be allocated to programs for rural electrification, energy efficiency, and electrical power for low-income users. The RGR is expected to generate resources of about R$ 1.2 billion up to 2010.

Fuel Consumption Account (CCC)

Fuel consumption account is fund created by imposing tax on all Brazilian consumers. It was initially established to support thermal generation, which is mainly based on diesel and concentrated in the Amazonia region. This benefit was extended to rural electrification technologies when replacing diesel systems.

Energy Development Account (CDE)

CDE was created to fund renewable sources of energy and consolidate electricity services in the country. The fund for CDE comes from annual payment for the use of public assets (UBP), ANEEL's fines to concessionaires and permissionaires, and annual quotas to be paid from 2003 by agents that market electricity to final consumers, progressively replacing the levy to subsidize thermal generation in interconnected system. The law also requires that CDE should promote universal electrification in the entire country.

Other sources

The federal and state treasuries also provide fund for rural electrification. The federal fund is channeled through PRODEEM and the Ministry of Agriculture. At the state level, the largest source of funds for rural electrification is a loan from the World Bank to the northeastern states. The Japanese Bank for International Development (JBIC) has also lent funds to support the rural electrification program.

3.10 Tax Structure on Renewable Energy Equipments

Solar and wind energy equipment is currently taxed at the lowest rates ever, because of exemption from IPI and ICMS tax in order to make renewable energy more competitive relative to conventional energy sources. However, the peripheral devices like controllers, inverters, and batteries are not exempted from tax, so they have to pay overall taxes of 37%, 43% and 50% respectively.

The tax structure on selected renewable energy equipments is shown in Table 10.

Table 10 Tax on Selected Renewable Energy Equipment

Product	Import Tax (%)	IPI Tax (%)
Photovoltaic and Wind		
Solar Module under 750 W *	20.5	0
Solar Cell, not assembled *	15	0
Windmill for water pumping *	14	5
Wind Generator *	14	0
Micro Hydro		
Turbines and Water Wheels and electric generators	13	0
Biomass Generation		
Boilers, motors, gas turbines, heat exchangers	13	0

Source: ESMAP[4]

Note:
Import Tax *– Federally mandate product Specific Tax. General range 10-20%*
IPI Tax *– Industrial Product Tax (IPI) is a federal tax levied on most domestic and imported manufactured products. General range 0-15%*
ICMS Tax *– Merchandize and Service circulation tax (ICMS) is a state tax (paid only on value added) applicable to both domestic products and imports. The rate varies among states with predominant rate currently at 17%.*
* *Equipment exempted of ICMS tax*

4. Rural Electrification Best Practices and Lesson for CLV Countries

Brazil has demonstrated very well on how to achieve the objective of electrifying rural population even when the distribution system is privatized. So the policy initiatives taken by Brazil can provide very good lessons for the developing countries which are either deregulated or are planning to deregulate their electricity sector. Furthermore, the initiatives taken for the universal access by 2015 is very noteworthy. On top of that the Brazilian Energy Initiatives for the 2002 summit in Johannesburg where Brazil has proposed the summit to adopt the target of increasing the share of renewable to 10% of total energy use in all countries by 2010, was well appreciated. The analysis of rural electrification policy initiatives in Brazil has lead to the following best practices that can be a very good lesson for the CLV countries which are still in the initial phase of the rural electrification process (except Vietnam). Vietnam has achieved good electrification coverage of around 88% as of March 2005. So, it can now focus on off-grid rural electrification policies and programs to achieve the 100% coverage by 2020. The off-grid policy initiatives in Brazil and how they have achieved in the deregulated scenario can be interesting to Vietnam.

Setting the Target

The target for rural electrification must be clearly defined in terms of number of consumer to be benefited, capacity to be installed, technology mix and the time line together with the resource allocation. E.g. the Brazilian government has put forward the program for universal access to electricity by 2015 and has set the target to be met by the permissionaires and concessionaires (Table 6) in their operating areas. The government is also targeting to achieve the 10% share of renewable in the total electricity consumption in the next 20 years through the implementation of PROFINA second phase program.

The electricity coverage in Cambodia is around 15% and is one of lowest in the region. The Government has set the target to achieve 25% electricity coverage by 2010 and 70% by 2030. But no clear policies and mechanisms has been devised. The country is being served by 24 small isolated power systems, mainly based on diesel and the price of electricity is also one of the highest in the World (in rural areas it is in the range of US$ 0.3 to 0.90 per kWh). The target needed to be set for each of these sub-systems and also policy need to be established to fix the share of renewable in the system. The Cambodian Government with assistance from the World Bank is in the process of establishing Rural Electrification Fund which targets 45,000 new connection to rural grid by Rural Electricity Enterprises (REE), 6 MW of new mini hydro, 12,000 new solar home systems, 850 kW of new village hydro and is palling to achieve 5% of national installed capacity from solar and hydro.

The Government of Lao has set the target to achieve 90% electrification coverage by 2020. Some targets are set under Southern Provincial Rural Electrification (SPRE) project with GEF grant. Phase 1 of SPRE plans to electrify 52,000 households of which 10,000 would be off-grid. In phase 2 of SPRE, around 71,500 households will be electrified of which 20,000 would be off-grid.

The Government of Vietnam has set an ambitious rural electrification program to extend national grid to 90% household by 2005. The government has also set target to electrify 400 communes in remote areas that will not be in the reach of national grid, with the use of off-grid renewable energy technologies.

Identify the Technology Options

The technology options (grid expansion or off grid, conventional source or renewable) for rural electrification to be used should be clearly identified to suit the local needs and to achieve the least cost objective. To ensure energy security, the appropriate mix of resources must also be ascertained. The grid supply option is to be considered in the un-electrified households in urban areas while off grid options are more suited for isolated areas, far from existing grid. The *Luz-para-Todas* program considers all the technology options that can be either gird extension or off grid, while its predecessor program *Luz-no-Campo* considered only the grid expansion option. Other grid expansion program includes PROECILA (with focus of wind power), PCH-COM (with focus on small hydro) and PROINFA (with focus on renewable like solar, wind and small hydro). The other major off grid rural electrification program includes PRODEEM program

that considers all the renewable technologies with special focus on Solar PV systems for community application. A good example of technology mix is the first phase of PROINFA program under which, 1,100 MW of Solar, 1,100 MW of Wind and 1,100 MW of Small Hydro plants will start operating and supply electricity to interconnected grid.

Cambodia has very few indigenous resources and depends heavily on diesel fuel. Solar home system can have very good scope in Cambodia. Department of Technical Energy (DTE) in MIME is currently managing a renewable energy technology action plan (REAP) as part of the World Bank project which is setting targets for the next 10 years. The aim is to install 8 MW in the first two years providing supply to some 10,000-20,000 solar home systems for remote households and small communities. If successful, the program may be expanded to cover 70,000 homes over 10 years. To support REAP the government of Cambodia has committed that by the year 2007: about 6 MW of generating electricity will come from RE Technologies, including 3 mini-hydropower connected to mini grid and 3 economically profitable renewable energy technologies.

The main barrier in Lao PDR is the lack of technology diversity in off-grid solution. Presently only solar home system is being delivered as off-grid component even in places where hydropower is abundant. It is a result of unimpressive performance of village hydro and other off-grid supply and strong villager's preference for SHS. So special demonstration projects with focus on hydropower have to be established to achieve the least cost objective.

Despite high potential for wind and solar energy, their development is still in primitive stage in Vietnam. Special programs need to be launched to develop the market for these renewable technologies and to achieve the target of the government to electricity 400 communes beyond the reach of national grid.

Policy Changes and Adoption of New/Appropriate Policies

Table 8 and Table 9 summarize the different policy adopted to expand rural electrification and to promote renewable energy technologies. These policies were instrumental in achieving the universal electricity access by grid expansion as well as through off grid rural electrification option.

Concrete policy that favors renewable energy development, creation of rural electrification funds, incentives for low income population, free connection charges, subsidy to renewable energy technologies and subsidy to rural population has to be established in CLV countries.

Taxes

One of the most common barriers for the promotion of renewable energy for decentralized electrification is the taxes. Exemption in taxes can lead to wide spread use of these technology as it will make renewable sources cost competent with the conventional energy sources. In the case of Brazil where the solar and wind generators are subsidized heavily (Table 10) and are exempted from

Industrial Product Tax (IPI, 0-15%) and the Merchandize and Service Circulation Tax (ICMS, around 17%).

Similarly, tax reduction/exemption can be considered for renewable energy technologies like solar and wind in CLV countries. Since the countries are rich in biomass resources and are also locally available, the tax exemption can be extended to biomass generation and other cogeneration facilities.

Financing

Large resources are required to finance rural electrification project, and this requires creation of rural electrification funds. Several funds like RGR, CCC, and CDE (Section 3.9) are established in Brazil to finance rural electrification projects. The money for the funds will come from the user of electricity themselves. In case of RGR the fund is raised by compulsory contribution from concessionaires (which in turn is transferred in tariff) and for CCC the fund is raised by imposing tax on all electricity consumers. CDE fund is created with fines from concessionaries and with the money obtained from the use of public assets.

Cambodia is in the process of implementing Rural Electrification Fund with assistance from the World Bank through IDA, GEF, bilateral donors and small off-grid rural electrification fee paid by consumers connected to national grid. This fund will provide subsidy either at the supply side or at the demand side so that poor will get electricity at the low price. However, clear policy is required for the operation of the fund and other mechanism needs to be devised to ensure sustainability of fund.

In Lao PDR the Rural Electrification Fund is still under review at the ministerial level, while at Vietnam no provision of specific rural electrification fund was found.

“Ring-Fenced” Fund

The term “ring-fencing” refers to ensuring that funds are strictly accounted for and protected from any misallocation. In Brazil, Rural Electrification Fund (e.g. RGR, CCC, and CDE) and other mechanisms for financing capital investment for rural electrification are established. Also various Acts are enforced that allows agencies responsible for managing the funds to account for the additional financing resources for the electrification of the poor. Brazil is considered to be a model of how to “ring-fence” the funds for electrification of the poor.

Pro-Poor Measures

The remaining un-electrified households are the one that either have no access to electricity or are not able to afford the comfort of electricity. So pro-poor measure is necessary to protect the interest of the poor and should be a part of overall rural electrification process. To achieve the objective, the Brazilian government has implemented two distinct measures. One is the establishment of regional electricity tariff, such that the consumers in isolated areas and the areas with lowest electrification rates will pay the lowest tariff in comparison to other regions. The

next measure is to set policy that give preference of fund for the low income households and isolated regions. In Brazil, Law 9.427 was passed stipulating that half of the Reversion Global Reserve (RGR, a fund for grid expansion and rural electrification) be directed to the regions with the lowest electrification levels while the other half is allocated to rural electrification, energy efficiency, and electrical power for low-income users. The law also dictates that the concessionaires and permissionaires be responsible for the total cost of providing service to any new consumers, while the consumer need to pay only the tariff.

Residential low-income consumers are also given discount on their electricity tariffs. The discount is tapered according to the consumption level, so that those consuming up to 30 kWh per month pay only 35% of the overall tariff, while those consuming up to 100 kWh per month pay only 60% of the overall tariff, with the discount declining to zero for those consuming more than 220 kWh per month. The overall tariff however differs from concession to concession.

The preference to fund and subsidy to low income consumers in the regions with low electricity coverage is vital to scale up rural electrification program. The household sector is being cross subsidized in all CLV countries with low consumption household (generally less than 50 kWh/month) paying the lowest tariff. In Vietnam however, the Government specify the tariff ceiling for rural consumers and Chairman of Provincial People Committee define price for specific areas. So, the price of electricity varies from province to province. In Cambodia, the rural areas (which represent 5% of total consumption) are being served by 600 private Rural Electricity Enterprise (REE), which are unregulated and the price varies from US$ 0.30 – US$ 0.90 per kWh.

Technology Based Tariff for Promotion of RET

Renewable energy technologies (RET) are relatively expensive compared to the conventional technologies and hence the cost of electricity generation varies depending on the technology. To increase the share of these RETs in the total electricity supply, it is necessary to provide incentives to these technologies. Recognizing the fact, the Brazilian government has put forward the technology based tariff in its PROINFA program (Table 5). Under the program the highest tariff will be given for the electricity generated from the Wind energy.

Technology based tariff is not currently in practice in CLV countries and can be a better option to promote renewable energy technologies with increased private sector participation.

Bulk Purchase of Renewable Equipment

The least cost rural electrification objective from the use of renewable energy technologies and assurance of equipment standard can be made by purchasing the equipment in bulk through competitive bidding. This measure was adopted in PRODEEM program where photovoltaic modules were purchased in bulk by the central government and then transferred to municipalities based on their demand.

The CLV countries can implement similar approach to electrify schools, health facilities and other community applications to ensure rural development. However, this top-down approach should be accompanied with cost recovery scheme. Otherwise, the system will be unsustainable and may fail as has happened in many installations in Brazil.

Incentive/Support for Locally Manufactured Technology

One of the promising initiatives taken by the Brazilian government to promote and develop local manufacturing capability is mentioned in the PROINFA program. Starting in January 2005, the PROINFA legislation requires that 60% of the total cost of renewable energy technology (wind, small hydro and biomass) and services to be sourced in Brazil; only companies that can prove their ability to meet these targets can take part in the bidding process. In addition, from 2007 onwards, this percentage increases to 90%. Therefore, companies that already have manufacturing facilities in Brazil will therefore have a major advantage in obtaining these projects.

The CLV countries can adopt similar measures to develop in-house manufacturing capabilities of renewable energy technologies that will have positive effect on the economy. It will reduce the cost of equipment, develop local manufacturing base, create jobs, meet the local technology requirements and contribute to the national economy.

Connection Charges

Initial connection charges are a greater barrier to rural households than the monthly electricity bill. So to achieve the target of universal electricity access by 2015, the Brazilian government made provision in law 10.438/2002 and ANEEL resolution 223/2003, under which the new electricity consumers are not charged for the grid connection expenses.

This can be a very good lesson to scale up rural electrification in CLV countries. However, it should be backed up by rural electrification funds to compensate the cost of service to the implementing agencies.

Delivery Mechanism for Renewable Energy Technology

Innovative service delivery mechanism is required to have the rural community access to electricity via decentralized technologies. This can be achieved by providing credit mechanism to the entrepreneur that build energy technologies and distribute to villagers as in the case of *Luz do Sul* program. Under the program the entrepreneur who builds solar home system will get credit from bank and the users are required to pay the service fee. The credit and financing mechanism to the villagers for the purchase of renewable technology can also be channeled through the existing cooperatives such as APAEB (Association of Small Agriculturalists of Bahia State). APAEB runs the revolving fund and finance photovoltaic system for domestic use and also provide access to credit from Northeast development bank to its member to finance photovoltaic system.

In Cambodia, the current status of renewable energy technology is very primitive. So, suitable delivery mechanism like providing credit mechanism to the entrepreneur that build energy technologies and distribute to villagers (as in Brazil) or providing credit financing to rural cooperatives (as in Bangladesh), had to be implemented. Similar mechanism can be useful for Vietnam and Lao PDR.

In Vietnam currently Solar Photovoltaic is being deployed by Vietnam Women's Union (VWU) in partnering with the Solar Electric Light Company (SELCO) and the Vietnam Bank for Agriculture and Rural Development (VBARD). The arrangement makes use of a credit scheme where VWU markets SELCO's systems and administers consumer loans provided by VBARD, while SELCO provides systems and is responsible for service.

In Lao PDR, among various delivery mechanisms, the lease –purchase scheme that is being implemented by EdL (Electricity du Laos) appears to be most appropriate. It combines several attractive features like maximum feasible cost recovery, written contracts for service, low-cost equipment, and assignment of roles to actors.

5. Conclusion and Recommendation

The policy initiatives taken by the Brazilian government to expand access to electricity to rural population and to promote the use of clean energy has been very impressive. Furthermore, Brazil was successful in implementing the complex rural electrification program even after privatization of electricity sector. The clear and specific approach taken by the government and related agencies includes tax subsidy for renewable generation, creation of "ring-fenced" fund, free connection charge for new consumer, special measures for the low income population and achieving rural electrification objective through efficient public-private partnering, can be a very good lesson for the policy makers in the CLV countries. Since both Brazil and Vietnam has achieved a high level of electrification coverage and for Vietnam the remaining areas are the one that had to be provided with off-grid technologies. So, policy initiatives of Brazil with regard to off-grid technologies can be very interesting to Vietnam. Cambodia and Lao PDR are in initial phase of their rural electrification process and the initiatives of Brazil taken in past to scale up rural electrification can be interesting lessons for these countries.

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