

Alleviation of Energy Poverty through Base of the Pyramid Business Models:

The Cases of Grameen Shakti, Bangladesh and Sunlabob, Lao PDR

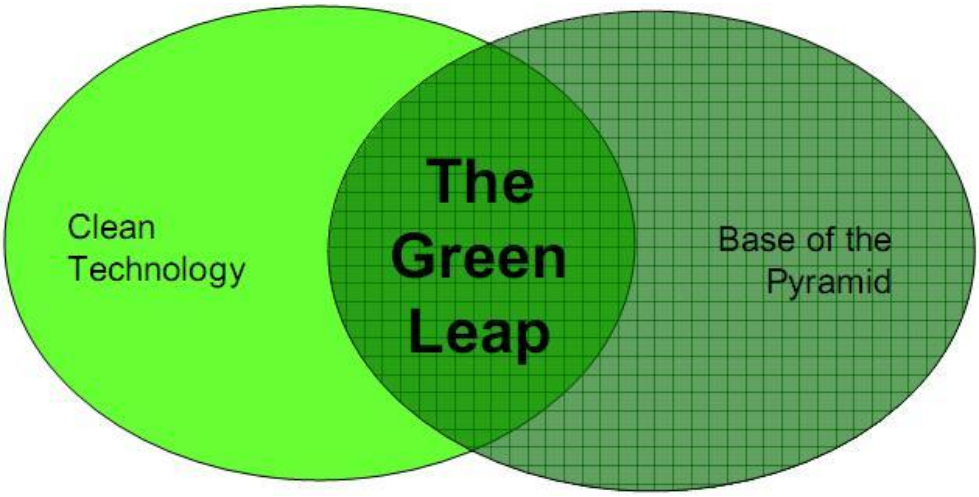

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Table of Contents

List of Table

List of Figure

List of Box

List of Abbreviations

AC	Alternate Current
ADB	Asian Development Bank
BoP	Base of the Pyramid
CFL	Compact Fluorescent Lamp
DC	Direct Current
ESCO	Energy Supply Company
FYP	Fifth Five year Plan
GDP	Gross Domestic Products
GEF	Global Environmental Facility
GIZ	German society for International Cooperation
GO	Government organization
GoB	Government of Bangladesh
GoL	Government of Lao
GS	Grameen Shakti
GTC	Grameen Technology Center
ICS	Improved Cook Stove
IDCOL	Infrastructure Development Company Limited
IPP	Independent Power Producers
JICA	Japan International Cooperation agency
kW	Kilo Watt
Kwh	Kilo Watt Hour
LED	Light Emitting Diode
MEM	Ministry of Energy and Mines
MNC	Multinational Company
MW	Mega Watt
NGO	Non-Government Organizations

NREDS	National Renewable Energy Development Strategy
NREP	National Renewable Energy Policy
PDR	People's Democratic Republic
PESCO	Provincial Energy Supply Company
PHP	Pico Hydro Power
PHP	Pico Hydro Power
PO	Partner organization
PPP	Public Private Partnership
PPP	Purchasing Power Parity
PV	Photovoltaic
REP	Rural Electrification Program
RET	Renewable Energy technology
SEDA	Sustainable Energy Development Authority
SHS	Solar Home System
SNV	The Netherlands Development Organization
TLE	The Law on Electricity
UN	United Nations
USD	United States Dollar
VAT	Value Added Tax
VEC	Village Electricity Committee
VOPS	Village Off-Grid Promotion and Support
Wp	Watt Peak

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Abstract

Currently, 1.4 billion people do not have access to electricity and most of them live in the rural part of developing countries. The present study has investigated-how BoP business model can alleviate energy poverty at the base of the pyramid. In doing that, two cases: Grameen Shakti (Bangladesh) and Sunlabob (Lao People's Democratic Republic) have been studied to explore their business models. They are implementing solar home system in off-grid areas in market based approach. Study reveals that local organization can alleviate energy poverty at the base of pyramid by adapting base of pyramid business model; investing resources for enabling business environment and; collaborating with government and communities. Besides, better knowledge of local organizations about local communities and conditions advance them to achieve co-creation and native capability in the business model. Study also finds that success of this kind of small scale renewable energy technology based base of pyramid business model depends on system of innovation, development of market ecosystem, impacts on customers and communities; and sustainability. Results of multiple case studies confirm that Grameen Shakti is successful in their dealer based base of pyramid business model by developing market ecosystem effectively and securing sustainability while Sunlabob fails to execute a profitable base of pyramid business due to weak regulatory environment.

Key words: Energy poverty, base of pyramid business model, SHS

1. Introduction

1.1 Background of the Study

Access to modern energy services is vital for developing countries (UNEP 2011). Because, energy drives human life and is critical for continued human development (Asif and Muneer 2007). Reliable and modern energy access (electricity, natural gas, clean cooking fuels etc.) is not only important to provide light during night time or cook food but also benefits directly by improving health, generating income, creating opportunities and extending education hours (Aron et al. 2009). Moreover, challenge of achieving of UN Millennium Development Goals (MDGs) to tackle extreme poverty in its many facets by the end of 2015 is inter-related with the provision of modern energy services (GNESD 2007). As for an example millennium goal of 'ensure environmental sustainability' (MDG 7) can be attain by promoting cleaner fuels, energy efficiency and renewable energy technologies (RETs) which ultimately reduce negative environmental impacts on environment locally, regionally and globally. Moreover, UN secretary General's Advisory Group on Energy and Climate Change (AGECC) published a report in April, 2010 and urged to UN and its member state to achieve two goals: universal access to modern energy services and a global energy intensity reduction of 40% by 2030 in order to achieve MDGs, improve the quality of macro-economic growth and reduction of CO_2 in next 20 years (AGECC 2010). Therefore, provision of reliable, affordable and modern energy services is very important for human development.

At present world, ensuring modern and reliable energy access in global scale is a massive challenge as because 1.4 billion people do not have access to electricity and 2.7 billion people use traditional biomass for cooking (IEA 2010). Use of traditional biomass (fuel wood, dung, refuse etc.) causes indoor air pollution and results 1.6 million deaths yearly (Aron et al. 2009). Besides, lighting by kerosene adversely affected the human health (WHO, 2009). Indeed, they are facing energy poverty due to lack of reliable, affordable, safe and clean energy services for lighting and cooking (Wilson et al. 2008). Most of these 'energy poor' live in rural areas of Africa, Latin America and Asia. According to OECD/IEA (2010), significant portion of people in developing countries still stay without electricity access and 85% of them live in rural areas of sub Saharan and south Asian countries. They are facing poverty penalty due to paying more than their wealthier part of society for same products or services (such energy services) (Hammond et al. 2007). Aron et al. (2009) confirms-'*for their money, they receive energy that is unreliable, expensive, hard to access, and unsafe*'. The situation of poverty penalty is even more clearly explained by OECD/IEA (2010), '*the rural poor without access to electricity either expend relatively large amount of their scarce financial resources on energy or a disproportionate amount of time collecting firewood'*. So, affordable and modern energy provisions are required to develop health, education, transport, telecommunication, safe water, agriculture and small industries for energy poor (Wilson et al. 2008).

Bringing 2.7 billion people of developing countries under modern energy services is challenging in many ways. Firstly, it requires large investment. According to Jhirad and Woollam (2007), about USD 16 trillion is

required in next 25 years. Among them, USD 9.6 trillion will be required by transitional and developing economies. On the other hand, AGECC (2010) mentioned that USD 35-40 billion capital investment per year is required to ensure universal modern energy services for meeting the basic needs by 2030. But reality is that, World Bank in total finances about 13 billion in 2010 for energy sector[1] to provide energy access to 1 billion people (World Bank 2011). Thus, current rate of financing against capital investment required per year for achieving modern energy services represents a large gap. Secondly, to attain modern energy access for developing countries, large public investment is necessary. But the efforts and investments up to date failed due to bureaucracy, inefficiency and low investment. For example in India they reached half of their electrification target over the last decade. However, South Africa has made an exception among developing countries by doubling electrification access in last 10 years (Aron et al. 2009). Thirdly, 85% of the energy poor live in the rural and remote areas of developing countries. Therefore, supply grid electricity to them is challenging in many reasons: far away from existing national and regional grid, difficult terrain (jungles, rivers, mountains), harsh climatic condition, dispersed areas with low population density, low load density and possibility of low revenue generation etc. Finally, existing electrification policies not include only this poor population but also various energy needs and target groups (big firms, big villages, small town). Ultimately, the remotely accessed energy poor remain out of electricity services. In this concern, International Energy Agency predicts that 1.2 billion people will continue without electricity access and 2.8 billion will use traditional biomass (slightly higher than current figure) by the end of 2030 if world communities rely on existing electrification policies (UNEP 2011). Therefore, analysis of challenges of universal modern energy access reveals the weakness of policies clearly and requires a dramatic change in the policy, planning and financing mechanism.

In such a situation where investment is insufficient; government is unable to execute energy access, conventional method of electrification is not appropriate and drastic change in policies and planning is a demand of time; then C. K. Prahalad and S. L Hart has brought the 'Base of Pyramid (BoP) concept' in to scene to alleviate poverty in its multidimension for achieving human development (Prahalad and Hart 2002). It has uncovered that 4 billion people live at BoP and income 1-4 USD/day/ person at local Purchasing Power Parity (PPP) (London and hart 2011; Hammond et al. 2007). Moreover, altogether BoP represents a market of 5 trillion USD at local PPP; which remains untapped by global Multi-National Companies (MNCs) (Hammond et al. 2007; Prahalad and Hart 2002). According to Kandachar and Halme (2008, 1), *'BoP approaches refer market based entrepreneurial activity aiming at poverty alleviation and development– tapping in to the previously ignored markets of economically most disadvantaged: the billions at the base of economic pyramid*'. With the span of time the concept has refined due to immense criticism from academicians, development communities, business people etc. (see detail in 3.2.8). In latest, BoP approaches count a broad range of business models designed by private sectors aiming BoP as consumers, produces and co-creators of business (London and Hart 2011). Therefore, BoP business model adapted by private sectors

[1] World Bank includes renewable energy; large hydro; coal, gas and oil; energy efficiency; transmission and distribution, thermal generation; and other energy in energy sector for financing.

can serve the poor profitably responding their needs of food stuffs, energy services, housing, health care, transport, telecommunication etc.

Scope of BoP business model in alleviating energy poverty has gained much interest to business and development communities (Wilson et al. 2008). Because, 4 billion BoP people include 2.7 billion traditional biomass users and 1.4 billion off grid people; spends USD 433 billion/year for energy services (Hammond et al. 2007). To utilize the market opportunities, private sectors can adapt BoP business model to bring energy access for people (Aron et al. 2009). Currently many multinational companies, local private companies and social enterprise have done it (Wilson et al. 2008). Aron et al. (2009) has identified 138 projects in 40 developing countries for modern, affordable and reliable energy services (Improved Cook Stoves-ICS, Solar Home System-SHS, solar lanterns, bio gas plant, grid electricity connection etc.). The customers of different energy services range from remote rural households to slum dwellers of cities. Moreover, the solution of energy services depends on the location and energy needs (Aron et al. 2009) (see table 1.1).

Table1.1: Size of BoP energy market

	Market Size (PPP in billion USD)		
	Cooking	Lighting and communication	Income generation and collectivities
Urban	92	88	45
Rural	164	75	60
Total	>250	>160	>100

Source: Aron et al. 2009

Most of the people (85%) without electricity access live in rural areas of developing countries and therefore known as 'off-grid people/ communities'. For various reasons (mentioned earlier), it is painstaking to hook up these households with conventional grid electricity connection with an aim to rural electrification[2] (OECD/IEA 2010). That's why, Hammond et al. (2007) demanded innovative approaches and new business investment to bring energy services for energy hungry BoP people. World Bank (2008) pointed out SHS, Wind Home system-WHS, Pico Hydro Power-PHP, mini grid, hybrid mini-grid and diesel generator, biomass gassifier as technology options for off-grid electrification. However, diesel mini-grids and diesel generators have some drawbacks (high fuel cost, difficulties to transport in remote areas, requirements of regular and skilled maintenance) and thus they become less preferable than renewable energy technology (RET) solutions. On the other, small scale RETs add various advantages over grid electrification and diesel based off-grid electrification options. Firstly, off-grid rural areas have abundant locally renewable resources such as solar radiation, hydropower, wind power, biomass resources etc. (Wilson et al. 2008). Therefore, no fuel cost is required to generate electricity. Secondly, small scale (kW level) and distributed RETs can supply electricity in the point of generation, accessible to remote locations (remote areas, hilly areas, coastal areas, islands) and match the specific needs of off-grid people (Kaundinya et al. 2009). Thirdly, RETs can be cost effective off-grid electrification solution than grid extension in sparsely populated remote rural areas

[2] Rural electrification is defined as the process by which access to electricity is provided to households and villages located in the isolated or remote areas of country.

with high transmission and distribution loss (Goldemberg 2000). Also, ESMAP (2007) found that RETs could be economically favourable than conventional off-electricity generation by diesel generator of less than 5 kW. Fourthly, UN (2010) and UNEP (2011) ensure the notable environmental advantages (reduction of GHGs emission, no or very less negative externalities of electricity generation etc.) of RET utilization. Finally, UNEP (2011) emphasizes the application of RETs for greening the energy sector for four reasons: existence of clear renewable energy targets in many developing countries, technological advances in RETs which increase competitiveness, recent strengthening in renewable energy investment and potential of RETs to create jobs. Moreover, RETs can be a sustainable part of rural development if the technology fits with social, political and technical basis (knowledge and skills) of rural people and therefore, improve their living standard (Bernett 1990). Thus small scale and decentralized RETs stand for low cost, sustainable and environment friendly solution for off-grid electrification.

Realizing these great strengths of RETs for off-grid electrification and potential of BoP energy market, private sectors of developing world has experimented BoP business models to bring modern and affordable electricity access to BoP (Jhirad and Woolam 2007; Aron et al. 2009). Many of them such as Grameen Shakti (Bangladesh), Sunlabob (Lao PDR), SELCO (India), TECNOSOL (Nicaragua), Solar Energy Foundation (Ethiopia), Rural Energy foundation (Sub-Saharan Africa), Deng Ltd (Ghana), Zara Ltd (Tanzania) etc. are well known for their success in implementing SHSs with an intention to alleviate energy poverty at BoP (Ashden Awards 2011). These private sectors use different business models for delivering solar electricity services for BoP; which include cash delivery model, credit delivery model, leasing delivery model, subsidy delivery model and long term service model (Koirala et al. 2011). On the other hand, failure could also take place, as it is not possible to make all the BoP business profitable. However, BoP business model have the potential to alleviate energy poverty.

1.2 Energy Situation in Bangladesh

As developing country of southern Asia, Bangladesh is facing power crisis about a decade along with other development challenges of poverty alleviation, malnutrition, employment generation, good governance, climate change etc. (World Bank. 2010a). Shortage of electricity production is about 1500-1800MW in comparison with peak demand (5800MW) and average production of 3900-4300MW, which has ultimately halted the expansion of grid electricity (MoF, 2010).

In Bangladesh, per capita energy and electricity consumption is 171 kg oil equivalent and 208 kWh respectively (IEA 2007; IEA 2010); the consumption figures are lower than other south Asian countries excluding Nepal; far more less than world average and indicate the insufficient access to energy and electricity services for lighting and cooking (Jonayed 2011). Further, only 47% people have access to grid electricity up to 2009; which comprises all urban areas and some parts of village areas (Power cell, 2009). However, Government of Bangladesh (GoB) has target to electrify whole country by the end of 2020 (PSMP 2005; NEP 2004), which requires innovative and sustainable off-grid electrification approaches along with grid expansion (where it is feasible) to hook up rest of rural households of remote areas, hilly areas, coastal

areas and islands overcoming the barrier of transmission and distribution losses, high subsidies, large investment of grid extension and low consumer density (Mondal et al. 2010).

Bangladesh is gifted with renewable energy resources such as solar, biomass, hydro, wind, tidal, wave and geothermal); among them solar, biomass, hydro and wind energy has proven potential (Modal and Denich. 2010). Government of Bangladesh has considers renewable energy a source of power generation due to attain energy security, meeting energy demand and providing modern energy access to rural people (NEP 2004). In 2008, National Renewable Energy Policy (NERP) has been drafted by Government of Bangladesh with an aim to develop renewable energy. The policy has set a target to meet 5% and 10% of total power demand from renewable sources by the year 2015 and 2020 respectively (NERP 2008). So, the combined efforts of public and private sectors can bring modern energy services for off-grid people.

Besides, Government of Bangladesh has established IDCOL in 1997(Infrastructure Development Company Limited) to provide financial supports (soft loans, grants, subsidies) to private sectors for implementing RETs (SHS-SHS, biogas technology, biomass, gasification, mini-grid, solar irrigation etc.). So, it can be said that private sectors are implementing RETs in Bangladesh to alleviate energy poverty.

1.3 Energy Situation in Lao People's Democratic Republic (PDR)

Lao PDR is least developed, land locked country of south-east Asia (Smits 2011b). The country has proven potential of hydropower due to access to tributaries of Mekong river, huge amount of rain fall, hilly terrain (70% of the country) and low population density that limits the human settlement mostly along rivers (Bambawale et al. 2011). Although, the country has 12 hydropower plants of 1839.01 MW of installed capacity to generate enough electricity for exporting to neighboring countries (China, Vietnam, Thailand), only 69% of Lao households have access to grid electricity. Because, 1300 MW of total installed capacity is owned by Independent Power Producers (IPPs) and they supply only 10% of generated electricity to Lao electricity grid (EdL 2009). Also, rough hilly terrain and low population density make grid expansion difficult and costly (Bambawale et al. 2011). Further, Lao PDR lacks of electricity infrastructures such as power plants, transmission and distribution line, transmission towers, sub stations and transformers (Smits and Bush 2010). Such a dilemma (plenty of electricity for export but difficult to domestic grid expansion) creates the scope of off-grid electrification using RETs such as SHSs, pico hydro, micro-hydro. Because, Lao PDR has proven potential of sunshine all over the country due to geographical location in between 12°-13°north and 100°-108°east latitude (PREGA 2007; Theumbounmy 2007). After realizing the potential of RETs for off-grid electrification, government of Lao has been implementing SHSs through World Bank's Rural Electrification Program; because, near about 42% villages are still not electrified (Bambawale et al. 2011 and EdL 2009). By this time, GoL has set a target to electrify the 90% of households within 2020 and among them 10% would be electrified by off-grid electrification technologies; which ultimately encourage the deployment of RETs in rural areas (Susanto and Smits 2010 and GoL 2001). Besides, National Renewable Energy Development Strategy (NREDS) has drafted in 2010 to promote and develop renewable

energy for supplying adequate energy to all people, attaining socio-economic development and environmental sustainability (NREDS 2010). The policy includes financial incentives and support to encourage private in renewable energy projects (NREDS 2010). However, participation of private sector in renewable energy sectors in Laos limited till to date (Smits and Bush 2010). Some PESCOs (Provincial Energy Services Company), install SHSs under World Bank's rural electrification program. Besides, activities of few private renewable energy companies are mentioned in PREGA (2007). But, Bambawale et al. (2011) and Smits and Bush (2010) confirm that only Sunlabob Renewable Energy Limited actively participates in renewable energy business by providing renewable energy solutions for off-grid people of Lao. So, regulatory environment and renewable energy private sector are in the stage of development.

1.4 Statement of the Problem

Bangladesh and Lao PDR are two developing countries of Asia and still away to connect all the households of respective countries with electrification facilities. In Bangladesh, Grameen Shakti-GS, the largest non-profit rural based renewable energy company in the world, implements RETs (SHSs, Improved Cook Stoves-ICS and biogas plants) in rural areas[3]. They install SHSs with the offer of micro-credit and effective after sales services (Grameen Shakti 2011; Jonayed 2011). On the other hand, Sunlabob Renewable Energy, a Lao based private company provide commercially viable renewable energy services mainly to off-grid rural people[4]. They provide affordable electricity services to off-grid people by utilizing SHSs, micro hydro, wind turbine, and village hybrid grid based on fee-for-services/ rental business model (Sunlabob 2011a; Schroeter 2009). So, it can be said that their business models of RETs can bring modern energy services to off-grid rural communities. Therefore, it could be imperative to analyze their business model in the light of BoP business model of alleviation of energy poverty.

Recent studies BoP business model confirm that not much have been done on alleviation of energy poverty through BoP business model. Among the studies, Jhirad and Woolam (2007) and Aron et al. (2009) reported nine case studies that analyzed different BoP business models for alleviating energy poverty. Again, Koirala et al. (2011) explain five types of business models with potential merits and demerits for implementing solar lighting systems (SHS and solar lantern) for developing countries. The results came from the case studies on different Indian renewable energy companies. In addition, Laufer and Schafer (2011) studied the engagement of Sri Lankan private sectors in dealer based business model for implementing SHS offering microcredit to rural people. In this study, the authors mentioned the limitation of this business model by concluding that off-grid Sri Lankan people with small business and regular income can pay the monthly installment of SHSs but poor with irregular income fail to pay the installments. Thus, the studies mentioned above mainly concentrated on technology (SHS) and business models but any information is not available about- how the BoP business models are developed (BoP protocol), how business models collaborate with market actors to overcome market conditions (market ecosystem), how BoP businesses change customers and communities

[3] Grameen Shakti also operate RETs business in urban areas but preferably well known for it's rural based RET intervention.
[4] Sunlabob has some on grid intervention as they installed grid connected PV system for German embassy in Vientiane.

(impacts of BoP business on the ground) and how BoP business model can secure the sustainability (sustainability). Realizing these knowledge gaps, present study is under taken to investigate-how BoP model can alleviate energy poverty based on the business models of Grameen Shakti and Sunlabob. To achieve useful outcomes, BoP business models are studied in broader context: country perspectives and organization perspectives. Country perspective is analyzed to gain sound knowledge on business and regulatory environment; which includes the topics: RET practices in respective countries, BoP market information and stake holders of renewable energy business. In case of organizational perspective, genesis of the organization, business model, market ecosystem, impacts on the ground and sustainability are analyzed carefully to identify whether the business models are successful BoP business models or not. Finally, it can be said that integration of all relevant knowledge in line with BoP business model for alleviating energy poverty will overcome the knowledge gaps of previous studies mentioned above.

1.5 Research Question

The core question that will be tried to solve in the study is-'How BoP business model can alleviate energy poverty?' To answer the core question the following working questions are taken in to consideration.

1. How BoP Business model contribute to alleviate energy poverty in developing countries?
2. How Grameen Shakti's (GS's) business model alleviates energy poverty in Bangladesh?
3. How Sunlabob's business model alleviates energy poverty in Lao PDR?
4. What are the learnings from the studied business models?

The working questions, sub questions and outcomes of the research work are presented in the table 1.2

Table 1.2: Working questions, sub questions and outcomes of the study.

Working questions	Sub questions	Expected outcomes	
How BoP Business model contribute to alleviate energy poverty in developing countries?	What does BoP approach mean elaborately?	Knowledge obtained about BoP concept, BoP market, BoP business solution approaches, BoP business protocol, and evaluation criteria of BoP business model.	Chapter Three
	How 'Green Leap' business model alleviate energy poverty?	Knowledge obtained about Green Leap approach and business models.	
	What are the RET based BoP business models in practice?	Compilation of BoP business models experimented on the ground.	
How GS's business model alleviates energy poverty in Bangladesh?	What RETs are practiced in Bangladesh?	Best practiced RETs in Bangladesh	Chapter Four
	What are the BoP market constraints in Bangladesh?	Analysis of BoP market information and identification of market constraints	
	How GS's SHS business model alleviates energy poverty in rural Bangladesh?	Analysis of business model, market ecosystem, impacts and sustainability	
How SRE's business model alleviates energy poverty in Lao PDR?	What RETs are practiced in Lao PDR?	Best practiced RETs in Lao PDR	Chapter Five
	What are the BoP market constraints in Lao PDR?	Analysis of BoP market information and identification of market constraints	
	How SRE's SHS business model alleviates energy poverty in off-grid areas of Lao PDR?	Analysis business model, market ecosystem, impacts and sustainability	
What are the learnings from the studied business models?	Can local organizations alleviate energy poverty at BoP?	Strengths of local organization in BoP business	Chapter Six
	Is it important to collaborate with government for BoP business?	Role of government in BoP business	
	How soft loans, grants and subsidies help in BoP business?	Role of grants and subsidies in BoP business	

1.6 Justification of the Study

The Present study on–'Alleviation of the energy poverty through BoP business models: the cases of Grameen Shakti Bangladesh and Sunlabob, Lao PDR' bears significance in many ways to business communities, government, development communities and academicians.

Firstly, application of BoP business model for alleviating energy poverty could be new learning for business communities and encourage the participation of private sectors in renewable energy sectors. Also, successful BoP business model could be replicable to other geography if the business fits social, political and knowledge and skill level of the local people. Also, causes of failure in BoP business could be learning for business communities engaged in BoP business for improving further.

BoP business has immense impacts on government because it helps to bring modern energy access to energy poor, green the energy sector and lead the country to sustainable energy development. Outcomes of BoP business models and its impacts on people could provide useful feedbacks to government policy makers to develop and reform policies, which ultimately creates more enabling environment for private sectors.

The results of current study could also important to development partners and donor agencies to identify the effectiveness and short fall of development aids (grants, subsidies, soft loans) to bring poor people under modern and reliable energy access. Thus, the outcomes of BoP business model study assist to design development aid which can create opportunities to private sectors to develop market oriented sustainable solutions for modern energy access.

Finally, impacts of BoP business and outcomes of sustainability assessment of BoP business models could be subject of interest to academician for improving BoP business protocol.

1.7 Limitation of the Study

Some limitations have been observed during the study and that are presented below:

1. The author visited Bangladesh to achieve practical ideas on how GS's SHS business model contributes to alleviate energy poverty. Also, the interviews with experts and customers were taken face to face. But, in case of Sunlabob, telephonic interviews were taken as the mean of acquiring primary information on Sunlaob's business model and business environment for renewable energy of Lao PDR.

2. Impacts and sustainability of the business models of GS and Sunlabob are assessed only qualitatively

2. Methodology

2.1. Introduction

This chapter represents the methodological considerations of the research work for dealing the working questions mentioned in the chapter one. To explain the overall methodology, the chapter outlines the research strategy, research design, research methods for primary and secondary data collection and finally a framework for methodological organization of working questions. Research strategy section will describe the appropriateness of qualitative research for the current study. In research design section, the procedure of simple multiple case study design will be explained as it is selected as method of case study. Semi-structured interview method and purposive sampling method will be discussed as a method of primary data collection for this study. Finally systematic review method will be explained as mean of collecting secondary data.

2.2. Research Strategy

The problem statement of the research work is 'How BoP business model can alleviate energy poverty? Actually, the study will investigate how BoP business of small scale and decentralized RETs (such as SHS) can alleviate energy poverty. In doing so, a qualitative research strategy is taken into consideration. The interviews, reflecting the views of the participants, are intended to reveal a link between implication of BoP business model and alleviation of energy poverty through collected data; which characterize qualitative research. Alongside, deep and rich data in the context of BoP business for eliminating of energy poverty is collected and analyzed.

According to chapter one, adaption of BoP based business model by private sectors for implementing SHSs could bring electricity services for people living in off grid areas. At the same time, it could contribute to alleviate energy poverty by providing affordable, clean, safe and modern electricity service. So, the point of examination for the study will be whether locally organized BoP business of SHS can lessen energy poverty successfully or not? Therefore, there is a possibility of generate new theory from the study which proves the suitability of 'inductive approach[5]'.

2.3. Research Design

According to Bryman (2008), research design is the framework of collecting and analyzing data. The research designs can be classified into experimental, cross sectional, longitudinal, case study and comparative research design. Among them, case study research design is chosen for the current research work. As a reason, it can be argued that implication BoP business model by GS and Sunlabob to reduce energy poverty of Bangladeshi and Laotian cannot be done so easily, for instance, even, on the basis of a comprehensive questionnaire survey. In the study, the core question is-'how BoP business model can alleviate energy poverty'? The core question is analyzed with a set of working questions (mentioned in section 1.5). Although, sub-question like-'What RETs are practiced in Lao PDR' can be answered in quantitative method. But, all working questions need deep contextual understanding to answer such as 'how

[5] Inductive approach; where theory is an outcome of research

Sunlabob's SHS business model alleviates energy poverty in Lao PDR' or 'how soft loans, grants and subsidies help in BoP business?' In this regard, Yin (2003) also confirms that application of case study research design in investigating real life context such as implementation of BoP Business for reducing energy poverty. In addition he also pointed out the limitations of quantitative method for contextual investigations, as it is tough to control the context.

Yin (2003) describes two overall approaches of case study design: single case study design and multiple case study design. For this research work, multiple case study design is applied. Because, two cases; GS (Bangladesh) and Sunlabob (Lao PDR) were studied to obtain the answers of the working questions. It could also be possible to complete the study by applying single case study design. But, multiple case study design gives more compelling and robust results than single case study design. To make the multiple case study design of this research work robust and compelling, 'replication logic' is applied; which either generate similar results (literal replication) or contrasting results (theoretical replication). Generally, simple multiple case study design of 2 to 3 cases result literal replication. However, if the cases provide contrasting results, the problem can be solved based on the guide of Yin (2003), *'.....the contexts of the two cases are likely to differ to some extent. If under these varied circumstances, you still can arrive at common conclusions from the cases,....*' . Therefore, application simple multiple case study design provides the strength of generalized conclusion, even the two cases represent different results. For the current study, simple multiple case studies with theoretical replication is taken into consideration as two case studies could come up with different results.

Besides, good preparation and conduction of multiple case study design requires consideration of five issues: desired skills of the case study investigator, training for the case study, development of case study protocol, screening of the cases to be studied and conduction of pilot case study (Yin, 2003). In this study, the researcher tackled the issue of skill and training on this specific type of case study through his previous experience[6]. Case study protocol was developed according to the guideline of Yin (2003). The issues of protocol development were taken seriously as it is pre-requisite for multiple case study design. So, protocol development process was studied deeply and described in detail in section 2.3.1. In case of screening of case study, three cases (Grameen Shakti-GS, Sunlabob and Simpa Network) were considered primarily for this study. Finally, GS and Sunlabob were selected after confirming assistance and cooperation from the respective companies for the current study. A pilot study was not taken into consideration due to time and financial constraints. However, the author went to short field trip to Bangladesh to conduct the case study on GS.

For conducting case studies, semi-structured interviews have been used with an interview guide that helps to maintain the line of inquiry (Yin 2003). Furthermore, the quality of the present case study is assured by four logical tests: construct validity, internal validity, external validity and reliability (Yin 2003). Collecting data

[6] The author has done 2 projects based on case study method. Also he completed the courses on research methodology

from multiple sources ensures construct validity of this study. So, interviews are taken from more than one person and secondary sources (journals, reports, books etc.) are used. Internal validity is maintained using explanation-building tactics. According to Yin's considerations concerning explanation building, case study data are analyzed in narrative form; which describe relationship between BoP business model and alleviation of energy poverty. Reliability of a case study is maintained by using common semi-structured interview guide to all interviewees so that same general outcomes can be achieved by using the same procedure. Therefore, it minimizes the biases and errors of the study. External validity is not confirmed in this case study as the study findings may not be generalized for other organizations and their initiatives related to RETs. The concepts applied to dealing with construct validity, internal validity, and reliability are shown in the table 2.1.

Table 2.1: Concepts used in case study to increase validity and reliability

Test	Case study tactic	Phase of the research in which tactic occurs
Construct validity	Use multiple source of evidence	Data collection
Internal validity	Explanation building	Data analysis
Reliability	Use of interview guide	Data collection

Source: Author's own elaboration based on Yin 2003

2.3.1 Development of case study protocol: Case study protocol contains instrument and procedures to conduct every single case under multiple case study design. Therefore, development of case study protocol is essential for keeping concentration of case study on the working questions the study, solving the overall problems, improving the reliability and the reporting of all the cases of multiple case study design (Yin 2003). So, case study protocol for this study was developed carefully to main the reliability and successful completion. The detailed protocol for the study includes several sections: overview of the case studies, field procedures, case study questions and guideline for the cases study report (Yin 2003). Firstly, overview of the case studies consists of overview of the current study and introduction of cases (GS and Sunlabob) to be investigated. Secondly, filed procedures include persons to be interviewed, field to be visited. As it is mentioned that only GS's filed was visited and related interviewees were interviewed directly. In case of Sunlabob, no visit was conducted and interviews were completed through telephone. Thirdly, two sets semi-structured case study questions were developed for investigating the business models and market information. Finally, outline of the case studies were presented in the protocol under the subsection named guide for the case study report. According to Yin (2003), outline of the case study report is important for collecting data properly and formatting the structure of the thesis and avoiding the revisit of the field. The case study protocol for the current study is attached in CD (appendix A).

2.4. Research Method for Primary Data Collection

2.4.1. Semi-structured interview method: Methods in the qualitative research are divided into participant observation, qualitative interview, focus group discussion and, collection and qualitative analysis of text and documents, which all can provide scientific knowledge in different levels and whose

appropriateness is determined by the aim of the study (Bryman 2008). In terms of the present study, the interview method was chosen to collect primary data as this approach raises the possibilities of active communication between the participant and the researcher related to the specific working questions of the study (Kvale 1996). Interview in qualitative research are divided into two types: unstructured interview and semi-structured interview. However, the semi-structured interview approach is chosen to deal with the working questions (particularly objective 2, 3 and 4). Before the interview session, two semi-structured interview guides were prepared for the interviews in order to ensure that all the key issues related BoP business models and alleviation of energy poverty were touched upon. To get insight into the issues, previous research in related fields (BoP business model and energy poverty) was studied. The interview guides are attached in CD (Appendix A). The advantages of semi-structured interview are that the interviewer has a fairly open framework, allowing a focused, in depth and two-way communications. The interviewer has a series of pre-decided questions but amendments can be done to the sequence of questions (Bryman 2008). Furthermore, a semi-structured interview allows us to give explanations or skip the questions that may appear redundant (Powney & Watts 1987; Rubin & Rubin 1995).

2.4.2. Sampling method: Purposive sampling allows the researchers to sample those who are relevant to working questions and thereby establish a good correspondence among them and is recommended for qualitative research based on interviews (Bryman 2008). In the study, a purposive sampling method was applied which meant that the people interviewed (the sample) were only those who had expertise in the field renewable energy, RET based business in the Bangladeshi and Laotian context. Thus, the respondents chosen for interview were very important for the getting information about the research. In total, eight persons were interviewed separately with semi-structured interview guide (see the appendix A of the attached CD).

2.4.3. Design of the interview guide: As mentioned above**,** semi-structured interview guides are used to list the issues to be addressed or questions to be asked. For designing the interview, a basic guidance from Bryman (2008) was followed which includes order in the topic of the interview guide, formulation of questions that are easy to answer, comprehensible language, avoidance of leading questions, assure the record of general questions (name, official designation, address etc.). All these conditions are fully met in the interview guide for maintaining quality. For the present work, two different interview guides were prepared for two different purposes. The first one was prepared for getting deep and rich information about renewable energy market of Bangladesh and Lao PDR (see the appendix A of the attached CD). The second interview guide was mainly prepared to get feedback from the experts about business model of respective companies by investigating their genesis, renewable energy programs, business models, marketing, implementation mechanism, environmental management and improvement options (see the appendix A of the attached CD. Two officials of GS were interviewed about their business model; while only one person from Sunlabob. In case of market information of Bangladesh, three experts were interviewed. On the other hand, two experts on Lao PDR were interviewed for market information (see the appendix A of the attached CD). For raising issues and formulating questions, an order of topic is maintained in both cases and the clarity of language

and comprehensibility of questions are ensured by conducting and recording the interviews in English and Bengali[7]. It is necessary to mention that three interviewees gave their interview in Bengali. The structure of two interview guides is presented in the table 2.2 and 2.3.

Table 2.2: structure of the interview guide for collecting data on market information

Main topics of interview guide	No. of question
Interviewee's information	4
Information about renewable energy resources and technologies	5
Regulatory environment for renewable energy development	4
Institutional issues for renewable energy development	4
Economic issues for renewable energy development	3
Policy issues for renewable energy development	4
BoP approach and alleviation of energy poverty	2

Source: Author's own elaboration

Table2.3: structure of the interview guide for collecting data on business model

Main topics of interview guide	No. of questions	Main topics of interview guide	No. of questions
Information about respondent	4	Technician training (only applicable for SRE)	3
General information about the organization	4	Village energy committee (only applicable for SRE)	2
Organizational information	6	After sales services (only applicable for GS)	2
General information about the programs	3	Information on payment from the customer	3
Project areas	4	Information on efficiency of SHS	3
Financing of renewable energy projects	5	Complaints of users	3
Marketing of renewable technologies	2	Environmental management	3
Market constraints	5	Impacts of SHS and solar lantern programs	3
Implementation of business model	4	Compatibility with BoP business model	2
Franchise development (only applicable for SRE)	2	Improvement options	6

Source:Author's own elaboration

2.4.4. Procedure of the semi-structured interview: According to Kvale (1996) there are seven steps in the process of interview investigation. These steps are thematizing, designing, interviewing, transcribing, analyzing, verifying and reporting. The structure that Kvale (1996) suggests has been followed in conducting the interviews in the current project. Thematizing is the process of formulating the working question to be solved, designing of the interview is done to complete the seven stages successfully and obtain the intended information from interview process. The phase of interviewing is conducted both directly and through telephone. Telephone interviewing is chosen because the interviewees were physically in a different country. Interviews were recorded as sound files (appendix B of the attached CD) and quickly transcribed to prepare a

[7] Mother tongue of Bangladeshi people

data matrix afterwards; and then they were analyzed based on the nature and topic of the investigation. After analysis of the interview, the findings from the interview process are turned into a readable product; the process called reporting. In the interview process, verification was ensured by maintaining validity[8] and reliability[9] (Kvale 1996). For maintaining validity, interviews are conducted to get information according to the objectives of the study. In addition, reliability is controlled in some cases by taking interviews in Bengali language and using same semi-structured interview guide for the interviewees.

2.4.5. Data analysis and interpretation: There are many ways of analyzing data generated from semi-structured interviews; mainly, this depends on the purpose of the analysis and 'intellectual craftsmanship' of the researcher (Mills 1959). In the current study, semi-structured interview produces lots of data. Therefore, a 'Matrix Display' method was used to analyze data because it's high suitability to handle large amounts of qualitative interview data, which is supported by Miles and Huberman (1994). For data analysis, a data matrix was constructed where questions were set out as the row headings and answers from the respondent were placed in the appropriate column (Mikkelsen 2005). Display matrices are available in appendix C of the attached CD.

2.5. Research Method for Secondary Data Collection

2.5.1. Systematic review: For literature review, a systematic review process has been followed. According to Tranfield et al. (2003), this is ideally seen as a replicable, transparent and scientific process of exhaustive literature search of published and unpublished studies. It helps unbiased and comprehensive accounts of literature. In this project work, a systematic review is mainly used for answering working question 1. Information collected from systematic review was also used along with primary information to answer rest of the working questions. To attain a good result for the review process, guidance from Miller (2004) was applied. Firstly, purpose of the review is defined according to the objectives. Secondly, criteria of literatures are assumed as such literature related to RETs, BoP business model and energy poverty. The literature review was conducted based on books, journals, reports and reliable documents. In addition, information was collected from internet sites related to this study. At the same time, sources of the literature are also recorded properly to make it reliable and accessible at any time.

2.6. Methodological organization of the study

The study is organized as a multiple case study research design where qualitative research strategy is followed in response to the working questions. Both primary and secondary data were used to deal with the research. More specifically, working question 1 was answered only by secondary information. In next, working questions 2, 3 and 4 were answered in combination of primary and secondary data. Table 2.4 shows the data sources of working questions.

[8] Validity in interview means whether interview study investigates what is intended to be investigated
[9] Reliability in interview refers how consistent the results are

Table 2.4: Relation between data source and working questions

Working questions of the study	Type of data used to deal the objectives
How BOP Business model contribute to alleviate energy poverty in developing countries?	Secondary data (journal article, book, report, internet website)'
How Grameen Shakti's (GS's) business model alleviates energy poverty in Bangladesh?	Primary data (semi-structured interview method) and Secondary data (journal article, book, report, internet website)
How Sunlabob Renewable Energy's (SRE's) business model alleviates energy poverty in Lao PDR?	Primary data (semi-structured interview method) and Secondary data (journal article, book, report, internet website)
What are the learnings from the studied business models?	Primary data (semi-structured interview method) and Secondary data (journal article, book, report, internet website)

Source: Author's own elaboration

2.7. Limitation of the Methodology

1. In this study semi-structured interview was conducted and conversations with interviewees were recorded. In next step, matrix display was prepared by listening the records instead of transcription of recording. As transcription was not done due to time limitation and display matrix was prepared, there could be a possibility of unclearness in data analysis. In addition, some of the interviews were in Bengali language and matrices were in English. There was chance to inappropriate translation from Bengali to English. These problems of qualitative research are identified as 'lack of transparency' by Bryman (2008).
2. Secondly, prepared display matrix could be send to the interviewees for rechecking their comments and increase the validity of interviews; which was not done due to time shortage and lack of interest from the interviewees.
3. Thirdly, only two case were studied under simple multiple case study research design. But one limitation of the case study method is that the outcomes case study based research can not be generalized (Bryman, 2008). Therefore, the outcomes of this study-'Alleviation of the energy poverty through base of the pyramid business model: the cases of Grameen Shakti, Bangladesh and Sunlabob Renewable Energy Lao PDR' can not be generalize for other private sectors implementing SHSs through BoP business models.
4. Lastly, some interviews were taken in telephone; it was not possible to understand how confidently they answered. Bryman (2008, 457) described this limitation of telephone interview- '*it is not possible to observe body language to see how interviewees respond in physical sense to questions'*. This limitation may reduce the validity of qualitative research.

3. Base of Pyramid Business Model: Theory and Practice

3.1. Introduction

This chapter will deal with theoretical background behind the Base of Pyramid (BoP) business model upon which this research is based on. To elaborate on the BoP, the following topics will be discussed: concept of poverty, international development challenges for alleviating poverty, BoP approach, the BoP market, BoP business solution approaches, the BoP protocol BoP business evaluation criteria, and the limitations of the BoP approach. Concept of poverty will be analyzed to gain knowledge about different perspective of poverty. The international development challenges will be discussed to investigate the reasons behind the evolution of BoP concept. BoP approach will be explained to attain knowledge about its ways to alleviate poverty. BoP market will be analyzed to obtain the market potential and market conditions. BoP business solution approaches will figured out with an aim to develop market ecosystem for BoP business model. BoP protocol will be described to obtain a better understanding about effective development of BoP business model. Theory of evaluation criteria will be described to with an aim to get a better understanding about the procedure of evaluating BoP business model. Finally, limitation of BoP approach will be discussed to identify its weakness for alleviation poverty.

Afterwards, the Green Leap approach is discussed to conceptualize sustainable solutions to energy poverty for the BoP. Finally, private sector's initiatives of Green Leap based BoP business model will be discussed to figure out the best practiced BoP business models for alleviating energy poverty.

3.2. Base of the Pyramid (BoP) Business Model: A Brief Analysis

3.2.1 The concept of poverty: Poverty is a burning issue for most of the world's population. It seriously undermines human capacity to meet their basic needs such as foods, clothes, safe drinking water, housing etc. control the quality of life (Kandachar and Halme 2008). According to the World Bank, poverty is a '*pronounced deprivation of wellbeing*' (Haughton and Khandker 2009, 2). Depending on the meaning of wellbeing, the concept of poverty can be explained through three perspectives (Haughton and Khandker 2009). Firstly, wellbeing means access to and control of resources. It mainly places emphasis on whether the households or individuals have sufficient resources to meet their needs. Thus, poverty is defined by comparing one's income with a defined income threshold, below which the individual is considered to be poor. This is the most conventional way of measuring poverty (Haughton and Khandker 2009). The second perspective goes beyond the income of an individual, where wellbeing is related to specific types of goods (such as healthcare, education, nutritional status, housing etc.) (Haughton and Khandker 2009). The third perspective is the broadest. According to Sen (1987), wellbeing rises when an individual has the capability to perform in the society. Therefore, poverty arises in the society when human being is short of capabilities, which result in a lack of income, health, shelter, security, freedom of speech etc. This perspective emphasizes the multi-dimensionality of poverty and demands integrated solutions in response. To put this capabilities approach in to practice, UNDP (United Nations Development Programs) has formulated Human

Development Index (HDI), where development of a country is being assessed by income, life expectancy and literacy.

According to the discussion on concept of poverty, it can be assumed that poverty has a broader sense than economic measurement of individual's income. Although, Sumner (2007) claimed that economic measures are more object oriented and therefore, still dominate in the poverty measures. But, addressing poverty in its multi-dimension has the strength to address not only poverty but also the product of poverty such as lack of opportunities to access in education, basic health care, drinking water and other matters that affect life. Due to this reason, it can also be said that today's poverty alleviation practice is also multidimensional such as the case of UN (United Nations) Millennium Development Goals (MDGs) in which alleviation of poverty is planned reducing poverty and hunger, promoting universal education, attaining gender equality, improving child and maternal health, preventing HIV/AIDS, achieving environmental sustainability and developing global partnership. This initiative ultimately supports multidimensional concept of poverty and alleviate it in an integrated way.

3.2.2 Poverty and international development challenges: At present, about 4 billion people live in the base of the economic pyramid (see figure 3.1) with an income of less than 5 USD[10]/day and are suffering from poverty relatively[11] (Hammond et al. 2007). But BoP authors pointed out different PPP (Purchase Power Parity). Such as, Prahalad (2006) found that more than 4 billion people income less than 2 USD/day, while Prahalad and Hammond (2002) argued for 6 USD/ day income for BoP. Therefore, the benchmark of income/ day ranges from 2-6 USD for BoP people (London and Hart 2011). But London and Hart (2011) emphasize the detail and in depth study report of WRI (World Resource Institute) and IFC (International Finance Corporation) on BoP population and market size where the report defines 5USD/day income threshold for 4 billion BoP people. However, only low income and purchase power parity can not define the BoP, they also include several other characteristics. Firstly, the BoP has significant unmet needs (foods, clothes, housing, health care, telecommunication, education, water and sanitation, energy services etc.). Secondly, they depend on traditional markets for livelihoods which mean that they are poorly integrated with the formal money economy (developed market) and; sell their products and labour to local employers and middle men, which limit their economic opportunities to upgrade life (Hart 2010). Finally, most of them are facing a poverty penalty by paying relatively higher prices for their goods and services than the wealthier part of society either in cash or in the efforts to obtain them. For instance, people at the BoP often pay more by traveling long distance to buy kerosene for lanterns (Hammond et al. 2007). Unfortunately, these billons of people are not only bypassed but also damaged by global capitalist economic system and therefore, maintaining their life by forced consumption of substandard products and services. Besides, they also face environmental degradation, loss of local autonomy, labour exploitation and loss of cultural hegemony (Hart 2010).

[10] United States Dollar
[11] Relative poverty is defined in terms of the society in which an individual lives that differs between countries and over time

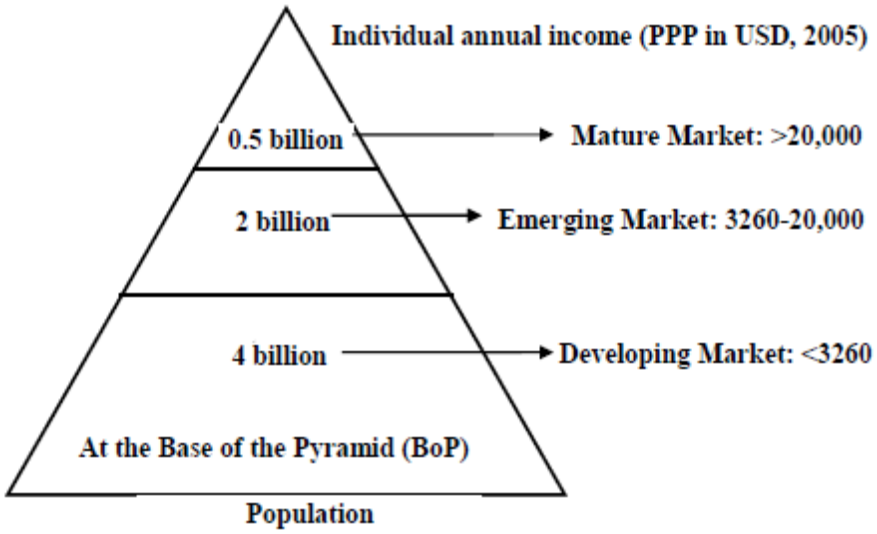

Figure 3.1: The world economic pyramid (WRI 2006)

To alleviate poverty and improve the quality of people at the BoP, development communities (international agencies, donor agencies, NGOs etc.) have been working for a long time. It is claimed by BoP theorists, however, that despite decades of efforts by development communities, neither development aid nor charity works can provide the solution of poverty alleviation (Kandachar and Halme 2008). This is claimed to be because, they only focus on providing for the needs of people who live on below 1 USD/day in local purchasing power parity, which is equal to 1 billion poor. Therefore, the rest of 4 billion people remain un-served and untouched by the ways development communities are working and need to be taken in to account to improve the living quality of BoP people (Hammond et al. 2007). In addition to this limitation, governments of poor countries are also unable to solve this problem alone due to ineffective economic policies, lack of transparency and weak democracy (Erixon 2005). As a result, the gap between wealthy and poor continues to grow. Statistically, in 2000, the richest 20% of global population controls 85% of GDP while the poorest 20% accounts 1.1% of GDP; which gives a ratio of 80:1. Back in 1960, the poverty gap ratio[12] was 30:1 that proves the increase of the financial gap between rich and poor (Hart 2010).

In 2000, the United Nations formulated a set of targets called the Millennium Development Goals[13]-MDGs for tackling the extreme poverty in its many facets by the end of 2015. But the reality is that up to now the achievements are not satisfactory in certain regions of the world. Sub Saharan Africa, eastern Asia and Oceania have been low performers till now. Progress in environmental sustainability and health care (goals 4, 5 and 6) are poor for all regions (Kandachar and Halme 2008). In this respect, Hart (2010, 12) claims that '*even after meeting the target of halving the people live below 1 USD/day by the year 2015, the number of poor will be more in 2015 than it was in 1990, which reveals the inefficiency of achieving the MDGs*'. This is also the reality in the case of the 'Kyoto Protocol', which sets targets for 37 industrial countries and the

[12] Poverty gap ratio is the mean distance separating the population from the poverty line (with the non-poor being given a distance of zero), expressed as a percentage of the poverty line.
[13] End of poverty and hunger, universal education, gender equality, child health, maternal health, combat HIV/AIDS, environmental sustainability and global partnerships

European community for reducing Green House Gas (GHG) emissions by 5% from 1990 levels from the years 2008 to 2012. In the case of Kyoto Protocol, Hart (2010) argues that a 5% reduction of GHGs emission within 2012 would not create any impact for stabilization of climate change.

At present, not only the poor are facing poverty, but also wealthy parts of the planet are going through a great financial crisis that started in 2008 that uncovered the shortcomings of the present practice of capitalism (Yunus 2010). According to Yunus (2010), capitalism misinterprets the human nature by considering it only in the dimension of profit maximization. In this connection, Yunus (2010, XV) argues that '*Human beings are not money making robots. They are multi-dimensional beings*'. Therefore, today's crisis has given us an opportunity to reformulate the economic theory that can able to represent the multiple aspects of human nature. People are today demanding an economy that makes sense for their business, community and family (Hart 2010).

The above mentioned discussions show that the world in the 21st century is facing lots of global challenges where states, international communities and development organizations are argued to have failed to solve development challenges efficiently to date. Regardless of whether the problems are environmental (climate change, ecosystem destruction) or economic (poverty, global economic crisis), ultimately it severely hits the 4 billion poor people who live at the BoP. Therefore, the demand is for sustainable solutions which address the economic, social and environmental challenges that the present world is facing (Hart 2010). This way of solution can also contribute to goal of sustainable development, which is to meet the needs of the present without compromising the ability of future generations to meet their own needs (Brundtland Commission 1997).

To succeed against the global challenges in a sustainable manner, the implication of multi-national corporations[14] (MNCs) are seen by BoP theorists to be a solution as they are one of the key players in global economy. There are more than 6000 MNCs which account 25% of global economic output (Hart 2010). Furthermore, Hart (2010, 13) justifies their importance by saying '*Indeed, MNCs have become the primary instruments of economic globalization facilitating the diffusion of more efficient and competitive business practices throughout the world*'. However, their products serve mostly the wealthy and emerging middle class customers of the market. Because of the business and financial ability of the MNCs, it is claimed that they can pursue business at the BoP through competing with government's the subsidies, incentives, lower cost. MNCs can do business at BoP by introducing 'inclusive business'[15]. Because, inclusive business contains the vision in which the voices, concerns and interests of people at the BoP are incorporated, bottom-up entrepreneurial activity is developed and local investment is encouraged. Also, Hart (2010) claims that such type of business also ensures the way of sustainable development. The ultimate result will be profitable

[14] Any corporations that operate more than one countries

[15] Inclusive business integrates people living in poverty in to the value chain as consumers or producers; thus making a positive contribution to the development of companies, local population and environment

business at the BoP which improves the quality of life for the world's poor by maintaining ecological integrity, respecting cultural diversity and building community (Hart 2010).

3.2.3 BoP approach: In the year 2002, C. K. Prahalad and Stuart L. Hart introduced the concept 'Base of the Pyramid (BoP)' in their article '*Fortune at the bottom of the pyramid'*. The BoP approach suggests market based entrepreneurial activity as a means to alleviate poverty and stimulate development for the 4 billion BoP people by integrating their untapped traditional market to the globalized market economy. The proposition was that it was possible to serve the poor people according to their needs through the market (private sector) with an aim to improve their life and thereby create a win-win situation for entrepreneurs (by gaining profit) and poor people (through alleviating poverty) (Prahalad and Hart 2002; Kandachar and Halme 2008). After introducing the BoP approach as a new form of business, it went on to gain immense response from academics, businesses and NGOs.

In the domain of the BoP approach, its interpretation varies and has developed over time, which is termed by Hart (2010) as first generation BoP and second-generation BoP respectively. In the first generation BoP, poor people are seen mostly as consumers, where MNCs and large corporations could find profitable markets by supplying appropriate and affordable products and services (Prahalad 2006). In the second generation BoP, the orientation is different and puts emphasis on 'co-creating' business models, technological solutions and value propositions[16] with BoP people. This new approach stimulates thinking on market development, partnership development, capabilities development and innovation. Second generation BoP is useful for poverty alleviation and implementation of green technologies but in practice yet by many private organizations, NGOs, international development agencies (London and Hart 2011). London and Hart (2011, 1) define BoP including both aspects mentioned above-'*The BoP domain comprises a broad range of business models developed by or in partnership with the private sector and specially designed to target the poorest segments of the society as a consumers, producers and entrepreneurs'*.

Assessing the propositions of the BoP approach critically it can be argued that the first generation BoP emphasizes the consumerism potential of BoP without seeing the poor as producer and co-creator of BoP business. According to this BoP approach, it is challenging for private sectors to sell products and services without improving the income. Moreover, it would not be possible to improve living standard of BoP people only through selling product. However, second generation BoP integrates BoP people as co-creator or producers. Therefore, it could help BoP people take part entrepreneurial activity which ultimately contribute to alleviate poverty.

3.2.4. The BoP market-size and characteristics: According to the International Finance Corporation and World Resource Institute, 4 billion BoP have purchasing power of 5 trillion USD[17] per year which is

[16] The unique value a business offers to its customers. It's why your customers will want to do business with you.
[17] Purchasing power parity (PPP) is a measure that equates the price of a basket of identically traded good and services across countries, providing a standardized comparison of real prices. In this research work PPP is considered in USD exchange rate of year 2005

considered as large potential global market for the private sector (Multinational Companies, large national companies, local enterprise, social enterprise etc.) (Hammond et al. 2007). The BoP market is not seen to be competitive and well served compared to mid-markets and wealthier populations. Most of the BoP market (40-70%) is characterized as being dominated by traditional market structures (informal markets) controlled by middlemen and local employers where low quality products and services are offered (De Soto 2000). Therefore, the proposition is that there is a huge opportunity to serve BoP people with world standard products and services affordably based on their needs (Hart 2010). Presently, the BoP market represents 72% of the world population. In future, this market will expand due to population growth (90%) in developing countries (Meadows et al. 1992). People at the BoP have estimated assets (house, land, equipment etc.) of USD 9 trillion but they do not hold any legal title and registration of assets because their assets are protected by informal property systems operated by local powerful people (De Soto 2000). Providing title of their assets is argued to help expand the BoP market in future (Hammond et al. 2007).

The BoP market mainly consists of the population of developing countries of Asia, Latin America, Africa, Eastern Europe and the Caribbean. The BoP market varies according to countries, sector and regions (Hammond et al. 2007). Firstly, the BoP can be differentiated as either rural or urban. Most of the rural BoP lives in Asia and Africa while the urban BoP market dominates in Latin America, Eastern Europe and Caribbean. Asia has so far the largest BoP market of 3.47 trillion USD, which is the sum of the income of 2.86 billion people (83% of the region's population). Eastern Europe's has 254 million people at the BoP (64% of the region's population) whose yearly income constitutes 458 billion USD. Latin America accounts for 509 billion USD of the BoP market covering 360 million people (70% of the region's population). Africa has a BoP market of 429 billion USD; which is slightly smaller than other regions, though it constitutes the region's dominant consumer market-71% of purchasing power parity (Hammond et al. 2007).

On the basis of sectors (food, water, information and communication technology, health, transportation, housing, energy, food, etc.), the BoP market varies widely. Water and information and communication technology account for 20 billion and 51 billion USD of the BoP market respectively, which reveals relatively small BoP sector markets. However, demand of information and communication technology to BoP people is increasing day by day. At the same time, health, transportation, housing and energy sectors account for markets of 179, 158, 332 and 433 billion USD respectively, all of which are higher than the water and information and communication technology sectors. Finally, food presents a largest market at BoP, amounting to 2,895 billion USD (Hammond et al. 2007). Figure 3.2 shows the BoP market of different sectors.

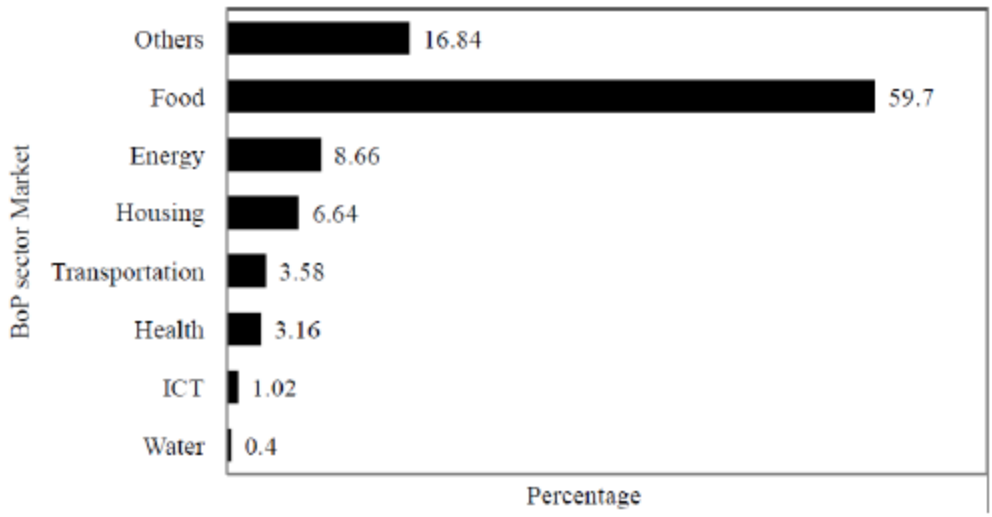

Figure 3.2: BoP sector markets based on USD 5 trillion (Hammond et al. 2007).

Also nature of spending of people at the BoP changes with the increase of income. Primarily, poor people spend highest for the food. But, when income increases, spending share for food declines, housing remains constant but spending on communication and transportation rises (Hammond et al. 2007). This is said to be because they communicate to improve social bonding. Therefore, BoP people not only meet basic need but also spend for higher order of needs such as face whitening cream or expensive clothes for a wedding. Besides this, the nature of spending also depends on how successfully any products and services meet their need (product design), the price of the products and services (affordability), how far they have to go for the product (accessibility) and how effectively MNC and large national companies communicate with them (advertising) (Subrahmanyan and Arias 2008).

As discussed previously, informal markets of developing countries dominate the BoP market. Gradl et al. (2008) argued that informality of BoP market is caused by five reasons. Firstly, it happens due to lack of market information such as spending power, customer's preferences and behavior. Secondly, lack of information about end user's knowledge and skills inhibits the utilization and valuation of products and services. It can be argued that as the BoP people live outsides of market economy, therefore no information about BoP is available to private sectors like MNCs and large national companies. On the other hand, it also justifies the strength of local entrepreneurs of informal market who have deep knowledge about BoP customers. Thirdly, the BoP market sometimes faces lacks in the regulatory environment, which is necessary to enhance the proactive economic activity. Fourthly, savings, transactions, insurance and credit facilities are necessary to enable business activity, but access to credit and insurance is very low to poor people in developing countries. Finally, BoP people are lacking physical infrastructure like transportation or internet connection which substantially increases the transaction costs.

According to the discussion on The BoP market, its size varies one region of the globe to another, one country to another country and rural to urban areas. Besides, it also fluctuates depending on different sectors of BoP markets. However, it has the potential for private sectors as because the market is underserved and

less competitive than mid and top of economic pyramid. Majority portion (40%-70%) of the BoP market is informal market and therefore, has different market constraints such as lack of customer information; lack of customer's knowledge and skill; lack of access to financial resources; weak regulatory environment and poor physical infrastructure. Therefore, entrepreneurs need to think about BoP business solution approaches to solve the market constraints to operate BoP business where BoP people can take part in the business intervention as consumer, producer and co-creator of business.

3.2.5 BoP business solution approaches: Understanding the BoP market not only helps to develop a BoP business model but also assists to overcome the market constraints. An individual entrepreneur can sometimes independently operate a successful BoP business model, but it can also be a collaborative effort between private sector actors (MNCs, large national companies, local organizations etc), NGOs and government organizations. Gradl et al (2008) describe five types of BoP business solution approaches; which are described below:

Adaptation of business model: Adaptation of business model by an organization brings a new way of business activity to overcome the constraints that exist in the BoP market. If the business model is successful, it scales up quickly. Later the model can be implemented everywhere. In this concern technology is an important factor for successful adaptation of business model. For an example, application of mobile phone in BoP market not only allow the customers to use telecom services but also provide different services like mobile banking, news services, educational information, remittance transaction etc. Ultimately, it scales up the mobile phone business (Gradl et al. 2008).

Invest in enabling conditions: In this approach, a business can invest resources to defeat the market constraints such as training and education for improving the knowledge and skill of the customers. When customers acquire knowledge and skills about a specific product, they will prefer to use it. But care should be taken to invest profitably which depends on the amount needed to invest and estimated benefit that will be generated (Gradl et al. 2008).

Collaboration with communities: Communities offer rich resources which include local knowledge, social networks, labour capacity, informal social rule, risk-sharing mechanisms etc. Working with individuals of communities means utilization of community resources and knowledge and at the same time provides income for the community people. Individuals from a community know very well about his or her neighbour's income, needs and preferences. When a community members work as service provider, vendors or trainers, it helps to build trust and explain the products and services to the customers easily. In addition, the social networks that exist among the members of a community facilitate the activities of members due to social rules and trust (Gradl et al. 2008).

Collaboration with other organizations: Collaboration with other organizations improves the opportunities of scale up the business and business activity. Business collaboration can be made with for profit organizations (multinational, national and local), private sector, public sector, international development

agencies, NGOs etc. Collaboration among organizations brings all kind of resources into the business efforts such as financial capital, technical capital, local knowledge, human capital, trusted relationships, infrastructural facilities etc. It helps to gain quick and successful scaling up of the business (Gradl et al. 2008). Collaboration with other organizations in the BoP approach increases the capabilities of the business. As an example, collaboration with microfinance institutions for BoP business facilitates the provision of microloans for potential customers.

Collaboration with government: Government has impact on the market through its implemented policies. Government's regulatory environment provides incentives and public services to the BoP business, which may ultimately create an enabling environment for the business activities. In many cases, government implements policies and regulations to open formerly closed markets for the business (Gradl et al. 2008). As for example, World Bank implements of SHS for off grid electrification in developing countries; which ultimately open up the market for small scale RETs (World Bank 2008). However, accurate design of policy and regulation requires deep dialogue among stakeholders of that respective business sectors (Gradl et al. 2008)

Based on the discussion on different BoP business solution approaches, it can be said that approaches are mainly framed to overcome or solve the market constraints. Adaption of innovative business model could help to avoid market constraints. But only adoption of business model may not be enough to overcome all constraints. In this case, investing in market, collaborating with other organizations and communities could provide solution. Finally, collaboration with government is important to implement rule of law in the market, open up new market, solve the constraints through changing and formulating policies. In conclusion it can be said that, success of BoP business depends on application of BoP business solution approaches as per the need of BoP business model.

3.2.6. The BoP business development protocol: A so-called BoP protocol has been developed to serve the need of business process for the BoP people. At the same time, it will integrate native capability[18] and embedded innovation[19] in BoP business model in a systematic way. The demand of protocol was arisen to guide the invasive, intensive and extractive nature of MNCs as well as ensure the development at the base of the pyramid. The BoP learning laboratory of Kenan Falgler Business School, UNC (University of North Carolina, USA) took the initiative. The protocol in its full form became publicly available in 2005. The protocol is designed to combine the knowledge of business, anthropology, human geography, social work, development studies and design (Wolfe et al. 2007). The protocol is not only applicable for BoP business in developing countries but also works developed world (Hart 2010). The Protocol consists of two phases: pre-field and post field phase (Hart 2010).

The pre field phase is discussed below.

[18] learning to engage extensively with the local people on their terms in true spirit of mutuality

[19] Co-creating a new business with community from the bottom-up, with the company a key part of this foundation. It requires mutual trust, relationship and understanding.

Co-inventing the company leadership team: A company's leadership team is set up consisting of 6-8 key executives with expertise in marketing, technology, production, human resource, finance, communication and sustainability. In addition, 1-2 key executives will look after the corporate or business part of the company. The main responsibilities of these executives are to implement the protocol, ensure bottom-up approach in and supply sufficient resources for BoP business development.

Forming field immersion team: An immersion team is built up with 4-6 people; 2-3 persons with knowledge on technology and entrepreneurial ability and 1-2 people with knowledge and experience on community involvement and BoP protocol.

Training of the team: The field immersion team takes training in BoP business concepts, team building, participatory methodologies and decision making. After training, 1-2 individuals from the local community of shanty town or rural areas need to be selected for immersion team.

Site selection: An urban shanty town or rural area is selected for BoP business development.

Local partner identification: After selecting the project site, the immersion team finds the local partner for the BoP business. Depending on the success of the field activities, the whole phase takes 6-9 weeks.

The next phase is the 'in field' part of BoP business development. The 'in field' consists of three inter-connected phases which are described below:

Opening up (Phase I): The immersion team stays in the community, and builds relationship and trust. This helps the co-creation of a business concept with the community partner integrating the resources, energies and capabilities of the community and company. This phase requires 3-4 months

Building the ecosystem (Phase II): In this phase, the network of partners does testing of a business idea to develop a business model. The result of this community-tested business model is the ready to run and scale up. In the meantime, a business organization is formed with community partners. Phase II takes near about 1 year to complete.

Enterprise creation (Phase III): The company and community partner starts a business in large scale with their product and services. In this phase, learning by doing approach is used to evolve the business model and build sufficient local management capacity to run the business. Finally, the company and community partners achieve a locally embedded business. The whole process of this phase takes 6-9 months.

The outcomes of BoP business development process integrate company's and community's capabilities, newly developed business and initial seed market. Altogether these elements make a platform to scale up the BoP venture. The business model of the BoP venture can be expanded, transferred and re-embedded to other communities of the same or different geographies in two ways. Firstly, 'applying organic propagation' method, it is possible to scale up the business model from the point of origin to entire the host community.

Second method is 'business transplantation'-spreading the business in new communities and geographies without following the whole co-creation process that took place in the first community. They make shortcut by employing a 'business ambassador' of the immersion team who took part in the co-creation of the business model. Therefore, it can be claimed that application of the BoP protocol can develop a business model which holds native capability, embedded in the local community (embedded innovation) and ability to expand in the other communities and geographies (Simanis and Hart 2008).

3.2.7. BoP business model evaluation criteria: BoP business can be evaluated in different ways: by analyzing market ecosystem, by recognizing the BoP business model as system of innovation, by assessing the BoP business impacts on the ground and finally by assessing the sustainability of the business in triple bottom line. The procedures to undertake these analyses are described below.

BoP market ecosystem: According to Gradl et al. (2008), market ecosystem results when market actors interact market condition (constraints). Generally, market actor means stakeholders for a business and market condition stands for constraints exist in a given market; which are relevant to all market actors. Changes in market conditions affect the activities for market actors. Conversely, actions of the actors change the market conditions (Gradl et al. 2008). Therefore systematic understanding on stakeholders and conditions is necessary for designing a BoP business model for a specific BoP products and services. Market ecosystem of a specific business elaborates (Gradl et al. 2008): what are the constraints in the market?; what are business model's own capabilities to overcome those?; How the capabilities of other actors in the market support to established the business model? and, what are incentives of collaboration? Gradl et al. (2008) developed a market matrix to analyze the BoP market ecosystem (figure 3.3). It can be argued that this matrix can be used either develop a market ecosystem or analyze the strength and weakness of the BoP business model.

		Solution approaches				
		Leverage own capabilities		Collaboration with other stakeholders		
		Business model adaptation	Investment	Communities	Organizations	Government
Market constraints	Market information					
	Knowledge and skill					
	Regulatory environment					
	Access to financial resources					
	Physical infrastructures					

Figure 3.3: Matrix for BoP market ecosystem

System of innovation: Freeman (1987) defines system of innovation as-'*.... network of institutions, public or private, whose activities and interactions initiate, import, modify and diffuse new technology*'. According to Malerba (2005), innovation system consists of three building blocks: technology and related knowledge

and skill; networks of actors; and institutions. These building blocks are defined by Mondal et al. (2010, 4627):

- '*Network of actors develop and implement new knowledge and technology within their institutional context'*
- '*Institutions involve formal institutions like law, government regulations and organizations, and technical standards and norm; and informal institutions like common law, cultural aspects, tradition, law, code of conduct, practices etc'*.
- '*Knowledge consists of hard technical knowledge and soft knowledge and skills such as how to use technology properly*.'

Mondal et al (2010) evaluated the success of small scale and decentralized RET implementation of Bangladesh by private sectors in the lens of system of innovation. Therefore, it could be logical evaluate the small scale RET based BoP business as system of innovation; which can investigate whether the business is successfully address the building blocks of 'system of innovation' or not.

BoP impact assessment: London (2009) has developed BoP impact assessment framework, which assess the changes in economics, capabilities and relationships among customers, sellers and communities rather than analyze the target achieved or quantity of products distributed or money spent in BoP business. In the impact assessment framework, changes in the economic stand for gain or loss in income, asset, liabilities etc. Capabilities mean influence in health, skill, confidence of individuals and communities needed to help themselves. Lastly, BoP business shapes relationship, provides access to network and partnership and; reduces social exclusion and geographic isolation (London 2009). The economic, capabilities and relationship changes that the BoP business can bring among customers, local entrepreneurs and communities could be positive and negatives. Thus it can be a criterion for judging the success of the BoP business.

Sustainability assessment: Motivation of BoP business model to alleviate poverty profitably is not enough to attain sustainability. To make it truly sustainable, effects of entire business system on environment, economy and society should be analyzed which ultimately encourage the triple bottom line (economy, environment and society) assessment. But, the BoP impact assessment framework of London (2009) can only assess the social and economic impacts and thus environmental impacts remain unevaluated. However, evaluating the impacts of business chain on environment is equally important. Therefore, assessment of sustainability of BoP business venture is crucial to identify and prove that problems solved by the business intervention are more influential than problems that would be created (Hart 2010). Generally, sustainability assessment has the strength to analyze the potential positive and negative impacts of BoP business on customers, communities and local entrepreneurs. Hart (2010) applied the triple bottom line assessment to investigate the sustainability of Grammen Bank's 'Village Phone' program. The generalized triple bottom line assessment framework for BoP business is presented in figure 3.4:

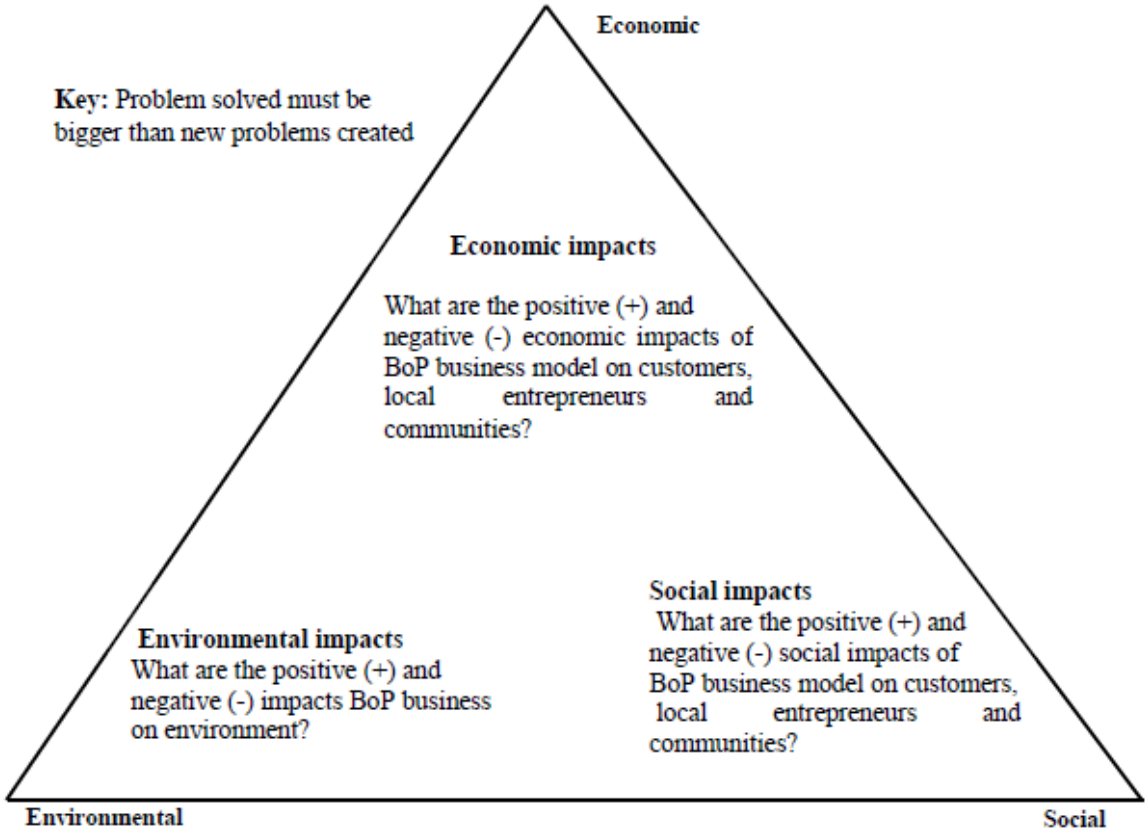

Figure 3.4: Sustainability assessment framework for BoP business (Author's own elaboration)

According to the evaluation criteria, it can be said that analysis of market ecosystem provides a clear idea about market actors of BoP business, market constraints and the possible solutions to overcome. Again, BoP impact assessment framework provides information about the economic, capability and relationship changes on the ground due to BoP business. Finally, results of triple bottom line assessment explain the sustainability of the BoP business. Therefore, at the end, it can be said that application of these evaluation criteria can judge a BoP business in all aspects.

3.2.8 Limitation of the BoP business: After the introduction of BoP business model, it has gained the focus in the arena of business, development and international community. A number of BoP ventures have been made to serve the poor in different parts of the world, both in the form of successful or unsuccessful business model (Hart 2008 and Hart 2010). Despite immense appreciation of BoP business as a new way of addressing poverty alleviation and attain development for the poor, there are some criticisms against it.

One of the first points of critique was a misconception about the size of the BoP market. Prahalad (2006) refers that 4 billion people living in the bottom of the economic pyramid with an income equal or less than 2 USD/ day. The number is criticized in Crabtree (2007) who argues that 2.8 billion people live on 2 USD/ day thresholds. This issue was clarified by Kandachar and Halme (2008), where they said that 4 billion BoP also include the emerging middle class of developing countries like China, India, Mexico those who income 5 USD/day than 2 USD/day.

Crabtree (2007) also casted doubts about the purchasing power of the poor with an income of 2 USD or less/ day. In this connection, Landrum (2007) advanced the debate by asking whether BoP approach was able to meet the need of the poorest people of the earth such as sub Saharan Africa. In response Stuart Hart, one of the pioneers of BoP approach explained that most of BoP initiatives do not really serve at BoP. He also claims that the BoP approach alone can-not solve the global poverty problem (Hart 2008).

Prahalad (2006) estimated the BoP market to possess 12.5 trillion USD in purchasing power parity combining the market of India, Russia, China, Mexico, Brazil, Indonesia, Turkey, Thailand and South Africa was a misinterpretation (Landrum 2007). The World Resource Institute and International Finance Cooperation found the number 5 trillion USD after an extensive household survey of 110 countries (Hammond et al 2007).

Another important proposition of the BoP approach is that MNCs should take the main role to sell quality products to the poor (Prahalad and Hart 2002). However, C. K. Prahalad's book- '*Fortune at the Bottom of the Pyramid'* elaborates 12 case studies as success of BoP approach where most of them are non-profit organizations and SMEs (Small and Medium Enterprises) (Crabtree 2007; Kranani 2007); which actually arise debate on the necessity of MNCs for BoP people, if SMEs and non-profit organizations can contribute successfully (Karnani 2007; Landrum 2007). Supporting the debate, Hart (2010) identifies the bottom up approach, less economy of scale, cultural and geographical advantages as success factors for non-profit organizations and locally grown SMEs in BoP market.

Prahalad (2006) stated MNCs can bring prosperity and alleviate poverty at the BoP by selling products that are affordable to poor and profitable for companies, thus creating a win-win situation for the BoP people and private sector actors such as MNCs. According to Karnani (2007), the BoP business model primarily considers the poor as consumers. However, it is argued that only selling to BoP people can-not bring prosperity or poverty reduction which is demanded by Prahalad's proposition (Karnani 2007; Landrum 2007; Jenkins 2005). Because BoP people hold a constant income, buying new available products from market creates a need to divert expenditure. It is argued that people at the BoP are not so rational in their expenditure. Ultimately, it can result in increasing poverty rather than decreasing it. This problem can be addressed by considering the poor as producers (Karnani 2007). To resolve this problem, Hart (2008) emphasizes to engage the poor as co-creation partners in BoP business models, so that they can be employed and raise their income.

Finally debate has risen about negative environmental impacts of products that private companies serve to the BoP market (Karnani 2007; Landrum 2007). In this connection, Karnani (2007) pointed out the use of single serve packets made of plastic. This creates environmental problems because in rural areas and shanty towns, inadequate or no garbage collection system is available. Addressing the environmental issue, Hart (2010) emphasized on the sustainability of the whole BoP business (both the end user and supply chain).

According to above mentioned discussion, different author criticized about the misconception of BoP market size, misinterpretation on BoP income threshold, consumerism tendency of BoP approach and weakness of environmental sustainability. However, Hammond et al. (2007) resolved the problems related BoP market size and income benchmark of BoP people. Again, evolution of 2nd generation BoP considers BoP people not only as consumer but also as producer and co-creator of BoP business. Moreover, London and Hart (2011) emphasizes the triple bottom line (economy, society and environment) assessment of BoP business which not only ensures the environmental sustainability but also social and economic sustainability.

3.3. The BoP Business Model and Alleviation of Energy Poverty

3.3.1 The 'Green Leap' business model: Inspite of having good motives to meet the needs of the BoP people, companies sometimes consume energy and raw materials intensively for production and sell products and services which are unsustainable for the environment (such as single served plastic sachets). Hart (2011) has introduced 'Green Leap' approach. Its strategy is to commercialize green technologies through BoP business models to leapfrog unsustainable technology practices. 'Green Leap' business model not only brings economic and environmental benefits but also argued to move towards sustainable development. It may be seen as a strategy to spread distributed and small green technologies which keeps to the bottom up approach and begins at BoP. Green leap business model will use the entrepreneurial spirit of MNCs, NGOs, local communities, GOs, investors, social entrepreneurs etc.

According to Hart (2011) green technologies are differentiated into two types: large scale centralized solutions (green giants) and small-scale distributed solutions (green sprouts). The green giants such as offshore or onshore wind parks, centrally controlled wastewater treatment plants, large scale solar farms etc. need policy changes, public investments and government subsidies to deploy it. Therefore, it is suitable for developed markets rather than the BoP. On the other hand, green sprouts like SHS (SHS), household biogas plants, micro-hydro, small windmills and point-of-use water treatment systems are small, distributed and disruptive to existing firms and institutions. In addition, there are two benefits identified by Hart (2010) for implementing green sprouts in the BoP market. Firstly, business models in the BoP market can also do business profitably in markets of higher income groups due to the low price. Secondly, the products and services offered from green technologies will be consumed by the BoP as they are served by substandard product and services. Not only that green technologies can also travel and compete with existing technologies of developed market if they can prove to be affordable, reliable and compatible with demands of multi-applications. Ultimately, it will reduce the big footprints (water foot print, carbon foot print etc.) of top of the pyramid consumers.

According to the potential of 'Green Leap' business model, it could be suitable for providing affordable modern and environmentally friendly electricity services. Green sprouts in this respect include small and distributed RETs such as SHS, wind home system-WHS, micro/pico-hydro, biomass gasifiers etc. These RETs are appropriate to meet the electricity need of off grid areas by avoiding large investment cost of

national grid expansion with associated transmission and distribution loss. In addition, RETs don't have any fuel cost and very low or no GHGs emission (Jhirad and Woolam 2007). Therefore, it can be argued that the Green Leap business model is appropriate for serving the energy poor at BoP.

However, RETs has some limitations such as high upfront cost (Urmee et al 2009) and therefore, are challenging to deploy in the BoP market. Therefore, innovative financial mechanism is necessary for operating 'Green Leap' business models. Government subsidies, microfinance, international grants and aid could be part the financial solution to reduce the system cost and increase the affordability for the customers (Jhirad and Woolam 2007). An understanding of local market conditions, the community and specific customers is important and key to success (Jhirad and Woolam 2007). BoP business model in this context need to achieve native capability by engaging local community as co-creator of business (Hart 2010). Therefore, a selection of appropriate small scale and decentralize RETs with locally embedded BoP business model could lead to a successful business for alleviating energy poverty.

3.3.2 'Green Leap' business models for off-grid areas: The main feature of the Green Leap business model is to meet the needs (such as electricity) of BoP people through the application of green technologies like SHS through a market based approach[20]. For off grid people, the World Bank supports five types of business models for electricity generations which include Private investor or operator based mini grid model, Community based Micro grid model, Energy Supply Company (ESCO) based micro grid model, fee for service model and dealer based model (World Bank 2008). The models are described below. Among them, dealer based model and fee-for–service model are PV based commercial dissemination model. Due to relevancy the current research work these two models are discussed below.

Dealer based model: In this model consumers buy SHS either by cash or credit with warranty of the system. To make the system affordable to customer, the dealer provides micro financing. Customers take the responsibility of operation and maintenance of the SHS (World Bank 2008). However the dealer could also take care of SHS under after sales service agreements with customers. The operation and maintenance services of Grameen Shakti (GS) provide a good example of this kind (Aron et al. 2009).

Fee for Services: In the fee for services model, the customers get electricity services from PV system by paying a monthly utility bill to ESCO. The services of electricity depend on the system's capacity. The operation, maintenance and replacement service of PV system (eg. SHSs) are provided by the company (World Bank, 2008).

3.3.3 Green Leap business models on the ground for lighting the BoP: Green Leap based business models are being practiced by MNCs, local companies, NGOs and community organizations to serve the

[20] A market-based approach focuses on people as consumers and producers and on solutions that can make markets more efficient, competitive, and inclusive so that the BOP can benefit from them.

energy needs in successful ways. On the ground practices related to RET based business documented in different literature are described below.

Jhirad and Woolam (2007) have described three types of business model for energy access at BoP. First, Shell Solar, a multinational cooperation, sells SHSs directly in non-electrified rural areas of India and Sri Lanka. To make the SHS affordable, Shell Solar arranges microfinance through a rural bank. In addition, they also provide maintenance services for customers on payment basis. Shell Solar received government and donor subsidies to reduce the system cost, train local technicians, raise the awareness of the local people. Secondly, An Indian private company, Decentralized Energy System India (DESI)[21] designs and constructs biomass gasification plant and hand over it's owner ship to local partners (NGOs, community based organizations, cooperatives etc.) after building up the capacity of the local partners. The model is known as 'Build-Own-Transfer' model where the DESI power company sells biomass gasification plant to the local partner, which then sells electricity to end users. Customers pay the utility bill based on the unit of electricity used. Lastly, IDEAAS[22], a Brazilian non-profit organization follows a 'Fee for Service' business model to sell the solar electricity generated from SHSs. To make the solar electricity affordable, they offer financing for installation fees to the end users and schedule the installment based on the seasonal income of the customers. IDEAAS has made an agreement with for-profit organization-Agro Electric System of Appropriate Technology (STA) for installing, maintaining of SHS and manufacturing some equipments of SHS.

Prahalad (2006) has described the initiative of E+CO[23] and Tecnosol[24] to promote sustainable energy for people at the BoP. E+CO provides investment capital for sustainable energy projects implemented by small and medium sized entrepreneurs in developing countries. Tecnosol is private renewable company in Nicaragua which sells RETs (SHS, solar water heater, wind turbine, etc.) and other electric appliances such as water pumps, fans, refrigerators, lighting systems etc. on cash. They follow a dealer-based business model without any consumer financing options (soft loans, micro finance etc.) with full assistance of installation and reliable after sales services.

Aron et al. (2009) has elaborated on the dealer based BoP business model implemented by Solar Electricity Company-SELCO[25] (for-profit company) and Grameen Shakti-GS[26] (non-profit private company). These companies provide microfinance facilities to the customers to make SHSs affordable. GS provide soft loans to customers with the financial assistance of the Infrastructural Development company-IDCOL (a Bangladeshi government organization). SELCO has signed agreement with financial institutions to provide loans to customers and have also established a guarantee fund. Guarantee funds lend down payment money (15% of system cost) for very poor customers. Both organizations have effective after sales services. On the

[21] For details: http://www.desipower.com/
[22] For details: http://www.ideaas.org/
[23] For details: http://eandco.net/
[24] For details: http://www.tecnosolsa.com.ni/
[25] For details: http://www.selco.com/
[26] For details: http://www.gshakti.org/

other hand, the Solar Energy Foundation[27] (a non-profit charitable organization) had adopted both a dealer based model and fee-for-service model. Customer can either buy a SHS on credit or pay utility bills based on their use. Aside from this, they train local youth as technicians for installation and maintenance after establishing franchised solar centers (Aron et al. 2009). Lastly, TEMASOL, a public-private partnership in Morocco for rural electrification, applies a fee-for-service business model where user pays 20% of installation fee and monthly rental fees (Aron et al. 2009).

In addition to the above, Schneider Electric[28] (SE) has launched LED lighting system in India under its BiP-BoP program. BiP-BoP business program stands for innovative electrical solution for developing business at the BoP, engaging the BoP people by improving their skill and competencies in electrical business. For Indian BoP people, SE has developed LED lighting system that is rechargeable either from grid electricity or solar electricity with a back up time of 8-15 hours. Therefore, it has promise to provide reliable light for 500 million people of India who are out of electricity. SE sells their LED lighting system through the NGO channels, microfinance institutions and trained entrepreneurs. Prior to launching the LED lighting system, SE has been providing electrician training since 2009 with an aim to develop 4000 skilled electrical professional by the year 2012. Later they will be encouraged to establish small business lighting solutions for rural people (Schneider Electric, 2010).

Simpa Networks[29], a US-based start-up technology company, has developed a so-called Simpa enabled SHS. This type of SHS is integrated with 'Simpa Regulator'[30]. They have developed a progressive purchase business model for installing SHS. Under this model customer makes payments (either by Simpa regulator interface or mobile phone or internet) and the Simpa regulator then allows for consumption based on the paid amount of electricity from the SHS. In this way, when customers pay the full cost of SHS, the SHS will be unlocked for 10 years. The total activities is managed by 'cloud based' centralized Simpa Revenue Management System Software. Under this model, consumer can pay and use SHS according to their need and need not to pay a fixed amount of monthly installment. The model is tested in India with collaboration with SELCO (Simpa Networks no year).

From the table 3.1, it can be concluded that among all the RET based business model tried out at BoP, dealer based and fee for service business models for RETs are relatively successful. Dealer based model is successful due to warranty of SHS and availability of consumer financing while fee for service model is accepted by customers as they have to pay the electricity bill only (World Bank 2008). In addition, local companies and nonprofit organizations are more active in energizing the BoP in a sustainable way. Hart (2010) argues that small scale local organizations understand local conditions well and more easily meet the market conditions than MNCs.

[27] For details: http://www.stiftung-solarenergie.de/
[28] For details: http://www.schneider-electric.com/sites/corporate/en/home.page
[29] For details: http://simpanetworks.com/
[30] Combination of tamper-proof microcontroller and user interface that regulates the function of SHS based on proof of payments

Table 3.1: Business models for lighting BoP

Company/Organization	Activity	Technology	Business model	Features of business model
Shell Solar (MNC)	Renewable energy development	SHS	Dealer based	Microfinance facilities for customers, After sales services
DESI (private company)	Renewable energy development	Biomass Gasification	Build-Own-Transfer	Training of local communities, NGO, cooperatives for operation and maintenance of plant
IDEAAS (Nonprofit organization)	Renewable energy	SHS	Fee for service	financing for installation fee
E+CO (NGO) and Tecnosol (private company)	Renewable energy	SHS, Micro hydro, wind turbine	Dealer based	Consumer financing, reliable after sales service
Simpa Network (Private company)	Renewable energy	SHS	Progressive purchase method	Flexibility in energy expenditure for customers
SELCO (for profit company)	Renewable energy development	SHS	Dealer based	Micro finance facilities for customers After sales services
GS (non-profit private company)	Renewable energy	SHS, Biogas plant, ICS	Dealer based	Micro finance, reliable after sales service
Solar Energy Foundation (non-profit)	Renewable energy	SHS	Dealer based, fee for services	Training of local youth on SHS, establishment of franchise
TEMASOL (public – private partnership)	Renewable energy	SHS	Fee for services	
Schneider Electric (MNC)	Energy efficient lighting	LED lighting system	Dealer based	Training of youth for small scale electrical business development

Source: Author's own elaboration

3.3.4 Implication of 'Green Leap' business model in the study: 'Green Leap' business model commercializes green technologies through BoP business model to leapfrog unsustainable technology practices. In this study, business model of GS and Sunlabob will be investigated to identify-how they alleviate energy poverty at BoP. They install SHSs commercially for providing electricity services to off-grid people. So, they implement small and decentralized green technology and replace unsustainable technology practices of kerosene lantern, diesel generators and candles. So their business motivation qualify 'Green Leap' business model. Besides, renewable energy business of GS and Sunlabob bring environmental and economic benefits by reducing greenhouse gas emission and providing electricity at competitive price. Moreover, it attains social development by improving living standard of rural people and ultimately leads sustainable development at BoP. Therefore, in this study, 'Green Leap' business model will provide theoretical framework for investigating the green technology based BoP business models.

Moreover, Hart (2011) mentioned six requirements for establishing 'Green Leap' business; which include community driven and locally embedded 'Green Leap' business model, co-creation of 'Green Leap' business model with local community, choice of green technology by BoP people, network of actors for implementing green technology, favourable policy and regulation for developing green technology and establishment of

'Green Leap' business development fund. In this regard, it can be argued that the line of inquiry that is designed for the study supports the Green Leap business model (see table 1.2). More specifically, the way business models of GS and Sunlabob are analyzed in chapter 4and 5, will support the implementation of 'Green Leap' business model. Therefore, 'Green Leap' guides the theory of this empirical study.

3.4. Chapter Findings

Four billion people are living at the base of the pyramid with significant unmet needs of essential of product and services (food, clothes, housing, health services, energy services etc.). Decade's long efforts of international organizations, governments, development agencies and NGOs fail to alleviate poverty and thereby basic needs of BoP remain unsolved. Ultimately, BoP people remain unserved and underserved by substandard products and services of traditional market.

In the age of globalization, private sectors (especially MNCs) are key player in the market economy. Realizing the strength of private sectors, BoP business model has been developed and put forward as a possible way to alleviate poverty and improve the living quality of BoP people. In BoP business model, poor are considered as consumers, produces and co-creators of BoP businesses.

BoP has an attractive market potential of USD 5 trillion that is concentrated mainly in traditional market of developing countries. BoP markets have characteristic constraints such as lack of market information, short of knowledge and skills of targeted customers, absence of financial services, weak regulatory environment and poor infrastructure. Therefore, BoP business models need to be developed market ecosystems that solve the market constraints by applying BoP business solution approaches in innovative ways. In this concern, investment of financial and technical resources by private sectors and; business collaboration GOs, NGOs and communities help to operate BoP business successfully.

Although, BoP business has got considerable attention in business and development communities, it has some limitations which were criticized by different academicians such as misinterpretation about BoP market size, BoP market potential, lack of environmental sustainability, and weak logic to support the business potential of MNCs at BoP. However, debate of environmental sustainability of BoP business has been addressed by Green Leap business model. Green Leap business model supports the BoP business model of distributed green technologies for the BoP market. Following Green Leap business model, distributed renewable energy technologies (SHS, wind home system, micro/pico hydro) are put forward as a possible solution for alleviating energy poverty at the BoP. For this reason, 'Green Leap' will guide the theory of this empirical study. Among several types of Green Leap business models that are applicable for lighting BoP communities, dealer model and fee for service model are widely used. Analysis of literature has also revealed that local organization and NGOs are more successful in Green Leap business model than MNCs. Because, they not only apply bottom approach in business and low economy of scale but also due to good understanding about local people and market condition.

4. Business Model of Grameen Shakti

4.1 Introduction

In broad sense, this chapter deals with business model of Grameen Shakti (GS) in two ways. Firstly, market information related to renewable energy sector of Bangladesh will be analyzed to identify the opportunities for private sectors. Secondly, business model of Sunlabob will be also investigated to find out how they are alleviating energy poverty through their business intervention.

4.2 Business Environment for Renewable Energy in Bangladesh

In this section, different aspects renewable energy business such as renewable technology practice and market information will be discussed with an aim to find out best practiced RETs (Renewable Energy Technologies), existing business opportunities for private sectors and market constraints. The outcomes of this section will be applied to evaluate the business model of GS.

4.2.1 RET practice in Bangladesh: In Bangladesh different kinds of RETs are in Practice; which include: SHS, Biogas plant, ICS (Improved Cook Stove), micro-hydro, biomass briquetting, biomass gasification (REIN 2011). The analysis of these RETs will give a clear picture of best practiced technologies in the country.

Solar Home Systems (SHSs): SHSs are the most popular RET in rural Bangladesh due to high modularity, no requirement for additional resource (e.g., water and fuel), no moving parts and low maintenance required. Furthermore, with an appropriate sunlight regime (20.30°-26.38° north latitude and 88.04°-92.44° east longitude) like Bangladesh, SHS has proved competitive for remote households. A typical A typical SHS consists of a 20 to 100Wp (Watt Peak) photovoltaic array; a rechargeable battery for energy storage; a solar charge controller; one or more lights (fluorescent/Compact Fluorescent Light-CFL/Light Emitting Diode-LED); an outlet for television, radio, cassette player, ceiling or table fan; switches; interconnecting wires and mounting hardware (see the Figure 4.1) (Mondal 2010).

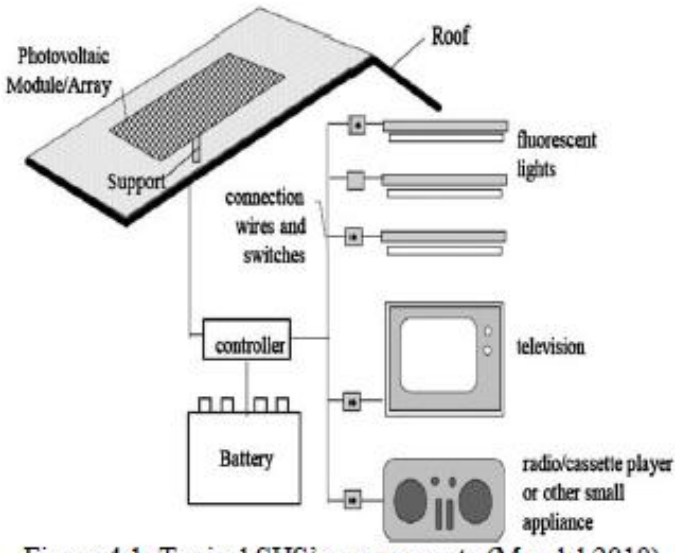

Figure 4.1: Typical SHS's components (Mondal 2010)

According to IDCOL (Infrastructure Development Company Limited), 801,358 SHSs had been installed by January 2011 by different private organizations (NGOs, company, non-profit company) in rural areas of Bangladesh (IDCOL 2011). Since 1990s, a number of pilot programs have been undertaken by different government organizations in Bangladesh to demonstrate the feasibility of solar PV, most of them donor supported. The main implementing bodies of solar energy programs at government level are BPDB (Bangladesh Power Development Board), LGEDs (Local Government Engineering Departments) and REB (Rural Electrification Board). In the case of the private sector, Grameen Shakti (GS), a non-profit company, has been a pioneer in disseminating SHSs in rural areas (details in section 4.3). Besides, RSF (Rural Services Foundation) has installed 127000 SHS up to now from 2006 (RSF 2011). BRAC, largest NGO in Bangladesh, BRAC has initiated solar energy program since 1997 with the main target being to electrify the rural and remote areas of Bangladesh. By the end of January, 2011, more than 65,572 SHSs have been installed by the organization (Mondal et al. 2010; IDCOL 2011).

Biogas technology: Biogas is produced from anaerobic digestion of biodegradable matter, which can be collected with the help of a biogas digester. Produced biogas can generate electricity by running internal combustion engine (diesel generator, gas generator) after desulphurization; which is applicable in lighting and using small electrical household appliances (GTZ 2010). Although many kinds of biogas digesters are available[31], fixed dome biogas digester are the most suitable **(**see figure 4.2**)** and widely used in rural areas of Bangladesh due to technical soundness and minimum maintenance required, if constructed properly (IFRD 1999). The Institute of Fuel Research and Development (IFRD) of BCSIR (Bangladesh Council for Scientific and Industrial Research) has developed design of fixed dome digester (Siddiqui 2003).

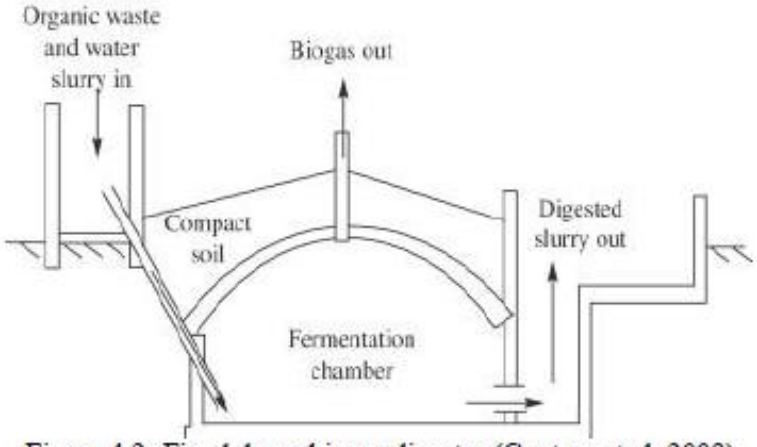

Figure 4.2: Fixed dome biogas digester (Gautam et al. 2009)

Biogas can be produced by using cattle dung, agricultural residue and poultry droppings; even from human excreta. It is a clean[32] form of fuel and the slurry (left residue of biogas digester) can be used as organic manure. A biogas digester of $2m^3$ requires 40-50 kg dung (4-5 cattle) per day, can produce sufficient energy for the cooking requirement of a family size of 5-7 persons (IFRD, 1999). Also, it has popularity in rural

[31] Fixed dome biogas digesters, floating dome biogas digesters, bag type biogas digersters etc
[32] Biogas is a mixture of several gases consists of methane (50 -70%), carbon-di-oxide (30-40%), low amount of hydrogen nitrogen, hydrogen sulphide and water vapor. It is odorless and colorless burns with blue flame similar to liquid petroleum gas.

areas due to availability of animal dung and poultry waste (40 metric ton/year) (Mondal and Denich 2010). By the end of December 2010, about 45,496 biogas plants have been installed in Bangladesh (IDCOL 2011; REIN 2011). Government organizations, NGOs and the private sector are disseminating biogas technology in rural areas of Bangladesh (REIN, 2011). Presently, 32 partner organizations (NGOs and private companies) of IDCOL are installing domestic biogas plants in rural areas under the financial assistance of IDCOL (IDCOL 2011).

Improved cook stoves (ICSs): IFRD (The Institute of Fuel Research and Development) of BCSIR (Bangladesh Council for Scientific and Industrial Research) has been working on stove technology since 1978 and on being able to make an improvement over traditional cooking stoves. The efficiency of newly developed cooking stoves ranges from 30-70%, while the efficiency of traditional stoves varies from 5%-15% (see figure 4.3) (Siddiqi 2003). IFRD (The Institute of Fuel Research and Development) has invented four types of improved cooking stoves: improved single mouth cooking stoves (potable), improved single mouth cooking stove (half underground), improved double mouth cooing stoves coupled with chimney (half underground) and improved double mouth cooking stoves coupled with chimney (on the ground). Besides the energy efficiency of cooking, there are some other advantages of ICSs: fuel savings (about 50%), smoke protection and thereby an improvement of indoor environment. Because of being thermally efficient, the resulting kitchen temperature is kept low (Hossain 2003) Different sources such as Hossain (2003), Grameen Shakti (2011), PCIA (2010), REIN (2011) and RSF (2011) confirm that about 437,103 ICSs have been installed to date by GOs, NGOs and private companies.

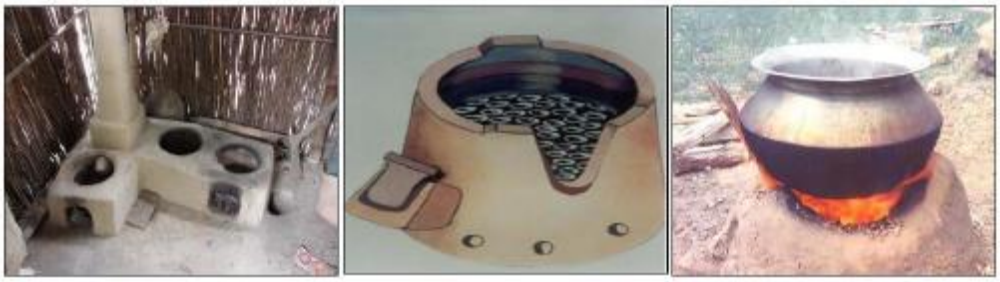

Figure 4.3: Improved cook stoves (middle and left) and traditional cook stoves- right

Micro hydropower: Aside from a few examples, the practice of micro hydropower is not common in Bangladesh. A tribal personality, Mr Khoin at Monjaipara of Banderban district of Bangladesh has installed a micro hydro power plant of 10kWp. A locally made fabricated wooden turbine wheel is used and electricity is generated to supply 40 households of the locality (Mondal and Denich 2010). Recently LGED (Local Government Engineering Department) has constructed a 10kWp micro hydropower plant in Bamerchara at Chittagong district. But due to inadequate water head 4kWp is generated currently (REIN 2011).

Biomass briquetting: A biomass briquette is a block of condensed biomass with increased volumetric calorific value for use as fuel. Different type of biomass like rice straw, rice husk, saw dust, wheat husk, jute

stick and bagasse can be used for producing biomass briquettes. Presently, only rice husks are used to produce briquettes in Bangladesh. Lots of crop residues are available in rural areas of Bangladesh due to agricultural practice. Therefore, biomass briquetting is good option for efficient use of biomass as fuel. Up to 2008, however, about 906 biomass briquetting machines were available in Bangladesh (Islam et al. 2008). Biomass briquettes are mainly used in hotels and restaurants for cooking purpose. In rural areas, its demand is less as the rural people collect their fuel wood mostly from village homestead forests.

Biomass gasification: According to REIN (2011)-'Biomass gasification is a process of converting solid biomass fuel into gaseous combustible form (called producer gas) through a sequence of complex thermo chemical reactions'**.** Islam et al. (2008) and REIN (2011) reported about 3 LGED (Local Government Engineering Department)-initiated demonstration projects on rice-based biomass gasification. Additionally, GS has imported a 10 kW biomass gasifier plant from India for implementing the technology in rural Bangladesh. Later, they failed to continue the demonstration projects due lack of availability of spare parts (Jonayed 2011). Besides these, IDCOL has financed 2 private companies for installing 250 kW and 400 kW rice husk based biomass gasification plant (IDCOL 2010). Therefore, it can be seen that biomass gasification technology is in the early stage of commercialization as few projects are under construction.

Other technologies: Bangladesh is still some way away from commissioning wind energy technology connected with the grid in any large scale. According to REIN (2011), 24 windmills have been installed under different demonstration projects for assessing available wind resources. BPDB has started a grid connected wind energy pilot project in Matamuhuri dam areas of Bangladesh, having an installed capacity of 0.90 MW (REIN 2011).

4.2.2 Best practiced RETs in Bangladesh: Based on the discussion on different RETs, SHSs are quickly scaled up in off-grid rural areas due to users friendliness, the ability provide light during night time and other limited but useful applications. ICSs are also widely used in rural areas, hotels and restaurants of Bangladesh as it can save fuel wood up to 50%-70%. Aside from these technologies, household biogas plants are popular in Bangladesh due to the high availability of biomass resources such as cow dung, poultry waste etc. It is notable that the implementation of SHSs and house hold biogas plants in rural areas by NGOs and private organizations are backed up financially by IDCOL (IDCOL 2011; Wiese and Steidl 2011). Therefore, SHSs, ICSs and household biogas plants can be argued to be best practice RETs in Bangladesh (see table 4.1**).** Furthermore, they can be termed as 'green sprouts' as they are small, distributed and environmentally friendly green technologies (Hart 2010).

Table 4.1: Best practiced RETs in Bangladesh

Renewable energy	Technology available	Number of Installations
Solar energy	SHS (Solar Home System)	80,1358
	Solar water heater	-
	Solar cooker	-
	Solar passive architecture	-
Biomass energy	Biogas technology	45,496
	Biomass gasification	6
	Biomass briquetting	906
	ICS (Improved Cook Stove)	43,7103
Hydropower	Micro hydro power plant	2
	Large hydropower plant	1
Wind energy	Wind mill	24

Source: REIN 2011; Grameen Shakti 2011; Islam et al. 2008; IDCOL 2011; PICA 2010; and RSF 2011

4.2.3 BoP market information: In this sub-section, market information for renewable energy business will be presented in different headings: customer information, financial services, physical infrastructures, regulatory environment and stakeholders. The intention behind this analysis is to find out the market constraints of renewable energy market of Bangladesh; which is very important for developing market ecosystem of a business model. Besides, it will also give ideas to private sectors about the market opportunities for renewable energy business in existing market condition. The market information will be presented below.

Consumer information: Bangladesh is a low-income country of more than 164 million people with a per capita income of 645 USD/year (World Bank 2010a). Among the population, only 27.1% reside in the urban centers while rest live in rural areas (ADB 2009a). As a low-income country, poverty is a pressing problem in Bangladesh, as because about 38.7% of people living below the poverty line[33] (in 2008). Among the rural people, 42.3% live under poverty (Planning Commission 2009a). Out of 28.67 million households of Bangladesh, about 51.33% earn their livelihood from agricultural activities (BBS 2008).

The household income of Bangladeshi's varies between rural and urban areas (see table 4.2). The percentage of low-income households is more in villages than city areas. Further, based on per capita income and income groups, it can be argued that almost all households belong to the BoP segment, though a few high-income households may exist in Bangladesh. Additionally, it can be assumed that, largest part of the BoP market is constituted by low-income households of rural areas.

[33] Per capita income less than 1USD/day in local purchasing power parity is considered as poverty line in Bangladesh

Table 4.2: Monthly income of Bangladeshi households

Income groups in USD	Percentage (%) of Bangladeshi households	
	Rural	Urban
<10USD	2.10	1.03
10 USD to 99 USD	73.18	55.85
100USD to 199USD	18.64	27.77
200 USD to above	6.08	15.35

Source: BBS 2010

In case of energy expenditure, Bangladeshi BoP spends 7.2% of their annual income for energy services (IFC/WRI 2007). According to table 4.3, rural people use more money per month for cooking fuel and lighting than urban inhabitants. It can be claimed that in Bangladesh, urban people enjoy subsidized grid connected electricity and gas connection (in some cities) whereas rural people have to buy low quality fuel like kerosene, candle, battery for lighting and in some cases, fuel wood for cooking.

Table 4.3: Average monthly expenditure of Bangladeshi house holds

Household	Percentage (%) of monthly consumption					
	Food and beverage	Clothing and footwear	Housing and house rent	Fuel and lighting	Household effects	Miscellaneous
Urban	45.18	5.84	16.79	5.50	2.39	24.30
Rural	58.54	5.54	9.78	6.11	1.81	18.22

Source: BBS 2010

In the case of education, adult literacy rates of Bangladesh are at about 59.1% estimated in 2008 (ADB 2009b) and therefore, more than 40% of people are still illiterate. In the case of universal primary education, rate of enrollment in primary level is 91.9%, while completion rate is 54.9% (estimated in 2008) for the respective age groups (Planning Commission 2009a). However, any market information is not available on knowledge and skill levels of Bangladeshi people, which can be influencing for BoP business.

Access to financial products: Access to banking, insurance and credit is very important in order to reduce economic vulnerabilities and utilize opportunities for people (Gradl et al. 2008). In Bangladesh, 47 banks [34] provide services such as savings, deposits and credit but most of them are urban centered (Bangladesh Bank 2010). Therefore, it can be said that rural people don't get the banking services easily. Additionally, it could be a factor that rural poor in many cases do not own enough money to use the financial services offered by banks.

Aside from the banks, 62 insurance companies (both general and life insurances) are operating in the insurance market (SBC no year). Most of them operate in the city areas where wealthy people live. It can be assumed that in rural areas, penetration of insurance companies is not so effective due to poverty and illiteracy[35].

[34] state owned bank, private commercial banks and specialized banks
[35] The assumption is made by author as he is a Bangladesh citizen by birth.

Furthermore, there are 2,017 registered NGOs in Bangladesh, working for socio-economic development (NGOAB 2011). Among them, 540 NGOs are registered with the Microcredit Regulatory Authority (MRA) of Bangladesh for operating microcredit to poor people (MRA 2011). Some large NGOs have countrywide microcredit operations like Grameen Bank, BRAC, Prosika, ASA (Association of Social Advancement) etc. Many small scale NGOs also distribute microcredit locally to the poor. Therefore, it can be assumed that people are getting micro-credit facilities easily in comparison with insurance and banking facilities.

It is interesting to note that the Micro-credit Regulatory Authority (MRA) of Bangladesh has reported some incidents of overcharging the interest rate from people by NGOs. NGOs fix interest in 'flat rate' as opposed to a 'declining balance' method of interest rate calculation. It is a different method than actual interest rates used by the NGOs for microcredit programs. In this method, microcredit borrowers in effect have to pay double the effective interest rate to the lending organization, because interest is charged on the initial loan amount rather than the outstanding loan balance. Therefore MRA (Micro-credit Regulatory Authority) has restricted the interest rate (maximum 27%/ year) for microcredit business of NGOs (MRA 2010).

Physical infrastructure: Lack of suitable physical infrastructure such as road networks, telecommunications and internet facilities increase the transaction cost of doing business (Gradl et al. 2008). Bangladesh has road network of 270556 km which can be characterized as main, classified and rural roads and only 30% of them are paved[36]. In rural areas, 39% of the population has access to an all-season road[37]. The road network is not satisfactory in rural Bangladesh, where most of BoP people live. Therefore, it is quite apparent that the price of product and services increases due to insufficiency of road network (World Bank 2011).

In the case of telecommunications, as estimated in 2008, 0.8% of population has a telephone connection, while 27.9 % of population use cellular mobile phone (World Bank, no year). This is despite 90% of population being covered by mobile phone network (World Bank, no year). Some cellular mobile companies such as Grameen Phone claim 100% network coverage. It is possible to access in internet services through cell phone connection but very few people (0.3%) use the internet in Bangladesh (World Bank, no year). Thus, it can be concluded that only a small portion of the population uses telecommunication services despite having satisfactory mobile communication. One reason behind could be the widespread poverty that doesn't allow people to use telecommunication services in large scale.

Regulatory environment: Under this heading, policies related to renewable energy development of Bangladesh will be discussed primarily with an intention to identify government's existing support for developing renewable energy and encouraging private sectors. Secondly, institutional support for RET implementation will be discussed to identify the scope of private sectors. Finally, under the sub-heading of 'stakeholders of the renewable energy sectors', different stakeholder's (public and private sectors) will be analyzed to find out their role.

[36] Made of bitumen and crushed stone
[37] roads that are access able to around the year by all means of rural transports

I. Policy support

National fifth five-year plan (1997-2002): The country's Five Year Plan (FYP) is Bangladesh's method of planning economic growth over a limited period; which is determined by the GDP growth for the planned years (Encyclopedia Britannica, 2010 and Planning Commission 1998). Energy has been a priority sector in every five year plan of Bangladesh, as it is vital for development. Renewable energy emerged as a sub-sector of energy and came first in second five year plan (1980-1985) (CREED 2001). In the fifth five year plan (1997-2002), objectives related to renewable energy development were to achieve the energy sector objectives such as promoting sustainable power development, encouraging the private sector with regard to power generation and expanding power supply to boost up the rural economy. To make this happen, specific strategies were taken in to consideration such as the application of RETs (SHS, biogas technology, ICS, micro hydro, ICSs etc), the implementation of the necessary institutional set-up (fiscal, legal and administrative arrangements among others) to enable successful RET applications. In fifth five year plan, the potential of different renewable energy sources and technologies was mentioned. Of particular interest concerning SHS technology, the duty free import of photovoltaic panels was suggested to reduce the cost of solar electricity generation (Planning Commission 1998).

According to the suggestion of the fifth five year plan, the Ministry of Finance has exempted import duty of in 1998 from solar PV modules (Sarker et al. 2003; Islam et al. 2008). That can be seen as a very important achievement for promoting the utilization of renewable energy. At the same time it can be argued that it will encourage the private sector to invest in power generation and renewable energy implementation.

After 2002 government shifted to PRSP (Poverty Reduction Strategy Paper) instead of five year plan and developed the first PRSP in 2003. But the development, promotion and dissemination of renewable energy for improved energy services as mean of poverty reduction came first in to PRSP in 2009. According to National Strategy for Accelerated Poverty Reduction-2009, RETs can bring improved energy services for remote, rural and isolated communities and thereby contribute to social and economic growth (Planning Commission 2009b).

However, some limitations can be found in the fifth five year plan such as there was no follow up about the achievement of fifth five year plan (1997-2002). Also, after 2002, any new five year plan was not developed by the government due to the agreement with World Bank to continue PRSP from 2003-2010. But, PRSP was unsuccessful as it was prepared by the prescription of World Bank rather than a home-grown mid-term national planning. However, government is planning to prepare the sixth five year plan for the years (2011-2015) (BBN 2009).

Revised Private Sector Power Generation Policy (RPSPGP), 2004: The GoB developed a private sector power generation policy in 1996 and revised it afterwards in 2004 for enhancing the participation of private investors to generate power so that they can contribute to economic development, avoid the existing power

shortage and meet the future power demand. Generally, power sector development is capital intensive and therefore, in the case of Bangladesh, it is donor dependent. So, participation of private sector could guide the power sector in attaining self-dependency. On behalf of MPEMR (Ministry of Power, Energy and Mineral Resources), Power Cell[38] facilitates the promotion, development, implementation, commissioning and operation of private power generation. Under this policy, independent power producers generate power and feed it to the national grid (Power Division 2004). Up to June, 2010, 27 power plants (Independent Power Producers) of 2014 MW installed capacity supply electricity to the national grid. But, none of them are renewable energy based (BPDB 2010). However, it is possible for private sector to install renewable energy based power generation. As an example, the GoB has planned to install a 100 MW offshore wind-park at Anowara in Chittagong district of Bangladesh by selecting independent power producers by international tender; which is currently under processing (Power Division 2011). Therefore, it can be concluded that policy support for independent power producers is available to generate power utilizing renewable energy. However, the policy assists the development of 'green giant' rather than 'green sprout' RETs.

Revised Small Power Plant in Private Sector Policy (SPPPSP), 2008: The GoB developed a small power plant policy in 1998 and later the policy was revised in 2008. The policy encourages private sector investors to install power plant up to 10 MW capacity for own use or selling electricity to customers. For this kind of plant, the government could supply fuel or they can manage their own. The owner of the small power plant has to find their customers to sell electricity. But the tariff of electricity will be regulated by GoB if they sell electricity in grid-connected areas. For off-grid areas, the tariff will be negotiated between produces and customers (Power Division 2008).

From the motives stated above in the policy, it can be said that government encourages the investment of the private sector in power generation. In this concern, it can be also argued that the policy could stimulate commercialization of green giants such as wind parks, solar parks both in on grid and off-grid areas by private sectors (Power Division, 2008).

Revised National Energy Policy (NEP), 2004: The first NEP was approved in 1996 to ensure the proper exploration, production, distribution and rational use of energy sources to meet the growing demand of energy by all people on a sustainable basis (NEP 2004). Later in 2004, the revised NEP has included the implementation mechanisms and procedures of exploration, production, distribution and utilization energy resources so that the energy policy can be easily transformed into practice. It has made interlink among important sectors (rural development, transport and industry). In addition, the revised version of NEP has set a target to electrify the whole country within 2020 (NEP 2004). Therefore, it can be argued that revised NEP (2004) is a step forward to formulate the modern energy policy of Bangladesh. The major objectives of the revised NEP (2004) include: provide energy for sustainable economic growth, meet the energy needs of different socio–economic groups, ensure environmentally sustainable energy development and encourage

[38] A division of Ministry of Power, Energy and Mineral Resources

public-private partnership in the energy sector. Key features about renewable energy development and opportunities for the private sector within NEP (2004) are given below.

Firstly, the revised NEP (2004) also encourages the promotion of environment friendly and sustainable energy that characterizes the applications of RETs. At current situation, renewable energy as a form of traditional energy source (biomass resources), is the main source of primary energy supply (35%-60%) of Bangladesh (NREP 2008)

Secondly, the revised NEP (2004) points out the utilization of renewable energy (solar, biomass, wind, hydro power etc.) for off-grid and hard-to-reach people[39] to meet their energy needs for socio-economic development. Also, it encourages the participation of private sectors in RET implementation. In this regards, the revised NEP (2004) provides guidelines for developing institutional arrangement, fiscal incentives, investment and regulatory measures for the national renewable energy policy. Therefore, it can be said that NEP (2004) has made a point of departure to formulate independent national renewable energy policy.

It is important to underline that the revised NEP (2004) is not approved by the government yet. Furthermore, the NEP (2004) is mainly based on conventional sources of energy (natural gas, coal, imported oil) (Doraswami 1996) and therefore, attention to renewable energy is relatively less.

National Renewable Energy Policy (NREP), 2008: The GoB has a plan to electrify the whole country by the year 2020 to eliminate the disparity of living standards between urban and rural people. At the same time, rural electrification is necessary to bring socio-economic development, as energy is a prime mover for development. Furthermore, global price volatility of fossil based fuels, climate change due to GHGs emission and feeling of energy security have led the GoB to develop the National Renewable Energy Policy (NREP) in 2008 (NREP 2008). The main objectives of the NREP include: harness the potential of renewable energy resources and the dissemination of RETs; encourage and facilitate both the public and private sector to invest in renewable energy projects; create an enabling environment and legal support to encourage the use of renewable energy and achieve the targets for utilizing renewable energy resources to meet 5% of the total power demand by 2015 and 10% by 2020 (NERP 2008). The key features of NREP (2008) are discussed below:

Firstly, the NREP (2008) suggests the establishment of a dedicated authority, the 'Sustainable Energy Development Authority (SEDA)' for sustainable energy development and promotion. The board of SEDA will consist of representatives from different stakeholder groups (GOs, NGOs, civil society, private sector, research organizations etc.) related to RETs. The main responsibilities of SEDA include: coordination of sustainable energy planning, promotion and demonstration of RETs, support the establishment of renewable energy enterprises; develop financing mechanisms and facilities for public and private sector investments; and enable systematic development of renewable energy projects and provide financial support in the

[39] Where grid electricity connection is expensive

research and development of RETs. Therefore, it can be argued that the establishment of SEDA will help the private sector in renewable energy business by providing legal, technical, and financial support; and knowledge and information sharing platform among stakeholders.

Secondly, fiscal incentives that are proposed in the NREP (2008) could be beneficial for private investors. Some of the main incentives include: exemption of charging 15% VAT of RET equipment; commercial lending for investors; micro credit support for end users; subsidies for renewable energy projects; land acquisition for renewable energy projects**;** corporate income tax exemption for five years**;** feed in tariff for green electricity etc.

Although NREP (2008) is a good attempt to develop renewable energy in Bangladesh, it has some shortcomings which should be taken into consideration. Firstly, NERP (2008) is approved by government; it is not yet converted in to 'government act[40]' due to lack of political commitment and strong interest of government (Uddin and Taplin 2009). Therefore, establishment of SEDA and approval of fiscal incentives for privates sectors remain in dark. Secondly, there is no clear guideline about how RETs will be implemented. Possibilities could be: small and distributed RETs (green sprout technologies) or large RETs (green giant technologies). But there is no clear indication in this regard.

Outcomes of policy analysis: According to the discussion of planning and policies related to RETs it is clear that the Bangladeshi government has been putting more emphasis on the implementation of renewable energy to provide energy services to off-grid people. Also, for city areas the government has a plan to make the utilization of PV technology mandatory. According to this policy 3% of household load has to come from solar energy (Khan 2011). However, Khan (2011) claimed that this initiative would be costly for city dwellers due to high initial cost of PV panel. Others reason that government has taken into consideration for utilizing RETs are the reduction of the dependency on imported oil and natural gas based power generation, attaining energy security and protection of environment.

Overally, the fifth five year plan addresses the potential of renewable energy. The revised NEP (2004) addressed the need for a separate renewable energy policy for environmentally sound and sustainable energy development. The revised private sector power generation policy-2004 and small power plant and private sector policy-2008 invite the private sector for power production where renewable energy based power generation could be an option. Finally, NREP (2008) provides a framework RET planning, development and implementation by including institutional arrangement, fiscal incentives, investment and regulatory measures. Also, NREP (2008) provides policy guidelines of fiscal incentives for the private sector to implement RETs. Although policies have been progressing to foster the growth of renewable energy in Bangladesh, there is no effectiveness in the implementation of policies such as revised NEP (2004) and NREP (2008) due lack of political commitment and government interest. Table 4.4 represents the issues related to RET and business opportunities for private sector addressed in different policies and planning.

[40] When any policy is approved by parliament, then it is converted in to a government act.

Table 4.4: issues related to renewable energy development and privates sector's business opportunities mentioned different policies and planning

		Issues addressed about renewable energy and private sector's business opportunities
Policies and plans	Fifth FYP (1997-2002)	1. Renewable energy potential 2. Import duty exemption on solar panel
	Revised NEP (2004)	1. Renewable energy potential 2. RETs for rural and hard to reach people 3. Emphasizes the necessity of institutional arrangement of RET application 4. Considers regulatory measures, fiscal incentive and investment for RET 5. Encourages private sector for RET implementation
	Revised PSPGP (2004)	1. Encourages the private sector to generate power for national grid
	Revised SPPPSP (2008)	1. Provision of small scale renewable based power generation by the private sector.
	N REP (2008)	Renewable Energy potential RETs for rural areas Institutional arrangement for RET application Implementation mechanism of RET* Regulatory measures, fiscal incentive and investment for RET Target oriented renewable energy technology development Investment and fiscal incentives for private sector

Source: Author's own elaboration. *not clearly specified in the NERP (2008)

II. Institutional support

IDCOL (Infrastructure Development Company Limited), a government owned non-banking financial institution, provides institutional support to private sector actors for implementing renewable energy projects in Bangladesh (especially in non-electrified rural areas). The institutional supports includes; loans for implementing renewable energy projects, grants and subsidies for installing SHSs and household biogas plants in off-grid rural areas; and technical, promotional, logistic and training assistance for renewable energy projects (Sharif 2011; IDCOL 2011; Wiese and Steidl 2011). Prior to establishment of IDCOL, donor agencies disbursed fund and grants to NGOs without any monitoring and accountability. After IDCOL was established in 1997, grants and funds were channeled in a systematic way with proper monitoring. Thus, it has proven to be a successful institution for supporting renewable energy implementation (Khan 2011).

IDCOL collects funds (loans, grants) from donor agencies for implementing renewable energy projects, and distribute the loans and grants to the partner organizations-POs (NGOs and private companies, non-profit organizations) for implementing RETs. POs install RETs among end-users either by cash sales or with the support of microcredit. Afterwards, end users repay the microcredit by paying monthly installment along with pre-fixed interest rate. Finally the money returns to IDCOL through POs (Urmee et al. 2009; and Mondal et al. 2010). Figure 4.4 represents the implementation mechanism of IDCOL.

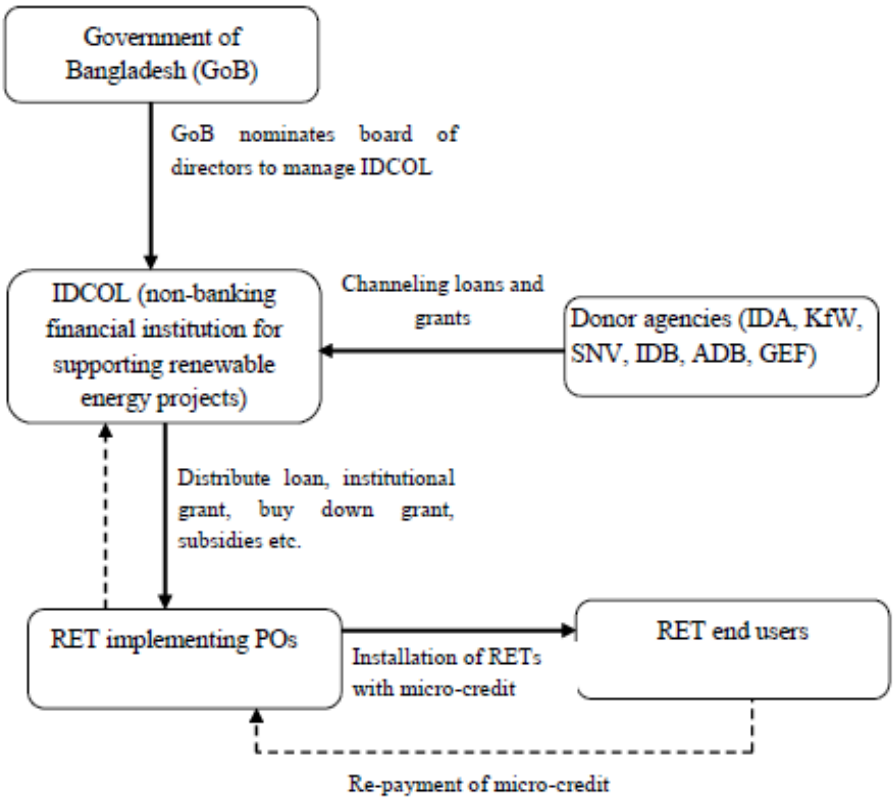

Figure 4.4: Implementation mechanism of IDCOL (author´s own elaboration)

Currently, IDCOL is receiving funds (loans and grants) from the Global Environmental Facility (GEF), the International Development Association (IDA) of World Bank Group, German Society for International Cooperation (GIZ), the Islamic Development Bank (IDB), the German Development Bank (KfW), the Netherlands Development Organization (SNV) etc. IDCOL on behalf of the government lends money from World Bank and Islamic Development Bank at a 3% interest rate and distributes soft loan (6%-8% interest rate for 7-10 years with a 1-2 year grace period) to end users through POs. IDCOL also provides buy-down and institutional development grants to 30 POs under the 'IDCOL solar energy program' (See table 4.5). However, they reduce the grants gradually to establish the renewable energy market and fully commercialize the SHSs (Sharif 2011). But, the journey of IDCOL towards commercialization of renewable energy by gradual phasing out of subsidies may fall in to challenge. Because, full commercialization of RETs would cause more high initial cost than present and thereby market might shrink in non-electrified rural areas (Khan 2011). Alternatively, it could be argued that, initial cost of SHSs may reduce in future due competition of private sectors.

Furthermore, they provide a subsidy of 9000BDT (1 USD=70 BDT[41]) for constructing family size biogas plants as per the specification of IDCOL under 'National Domestic Biogas and Manure Program-NDBMP'. Currently, 32 organizations construct households' biogas plants under NDBMP (IDCOL 2011).

[41] Bangladeshi currency

Table 4.5: Grants for IDCOL solar energy program

Organization	Amount of grant available per SHS		
	Total	Buy-down grant	Institutional Development Grant
The World Bank funds			
First 20,000 systems	$90	$70	$20
Next 20,000 systems	$70	$55	$15
Next 30,000 systems	$50	$40	$10
GTZ funds			
33,660 systems	€38	€30	€8
KfW funds			
First 30,000 systems	€38	€30	€8
Next 35,000 systems	€36	€30	€6
Next 35,000 systems	€34	€30	€4

Source: IDCOL, 2011

Based on the discussion on IDCOL, it can be said that institutional supports provided by IDCOL are only for the private sector to make them competent both technically and financially for future commercial exploitation of renewable energy. Beside the network of IDCOL, some GOs such as Rural Electrification Board, Local Government Engineering Departments (LGED) and the Bangladesh Power Development Board (BPDB) conducts some demonstration projects on RETs funded by donor agencies (REIN 2011). As for example Rural Electrification Board (REB) installed 12400 SHSs of 40Wp, 50 Wp, 80 Wp and 100 Wp capacity in off-grid rural areas under 'Rural Electrification through Solar Energy' program funded by World Bank during 2002-2008 (REB 2011). They actually, implement the 'fee for service' business model with regular maintenance of system[42]. But it can be argued that as such kinds of projects conducted by GOs are fully donor funded, and therefore they do not need any institution support.

III. Stakeholders of renewable energy sectors

Stakeholders are individual persons, groups and institutions with vested interests in an intervention. Stakeholders of an intervention can be identified by stakeholder analysis. Different stakeholders are related to renewable energy implementation in Bangladesh. Stakeholders of renewable energy sector of Bangladesh are analyzed by stakeholder analysis checklist of COWI (2000). The checklist consists of five questions: who depends on the intervention? who are interested in the outcome of the intervention? who will influence the intervention? who will be affected by the intervention? and who will work against the intervention?

By answering the first four questions; the stakeholders of the renewable energy program in Bangladesh are represented (table 4.6). However question 5, is not taken in to consideration because, no lobby was identified against RET application in non-electrified rural areas. However, GoB has made an agreement with Russian State Nuclear Company (ROSATOM) to install a nuclear power plant of 1000 MW within 2017-18 (The Financial Express 2011) which will cost 1.5-2 billion USD. Due to uncertainty of such as a huge investment, it may not be succeed in reality. Furthermore, provisions of renewable energy utilization for rural people are assured by NREP (2008), therefore, it could not hamper the growth of RETs in Bangladesh.

[42] The author collected this information through contacting Eng. Zafor Sadik, Executive Engineer, Rural Electrification Board, Bangladesh. Email: renewable_reb@yahoo.com.

Table 4.6: Stakeholders of renewable energy sector of Bangladesh

Stakeholders	Focus area	Example of stake holders
Focal point	Planning, development and promotion	SEDA- Sustainable Energy Development Authority (proposed). Power Division, MPEMR (currently acts as focal point)
Renewable energy research organizations	Research and development	Bangladesh Council for Industrial and Scientific Research, Renewable Energy Research Center (Dhaka University), and Centre for Energy Studies (Bangladesh University of Engineering and Technology)
Finacial organizations	Financing Renewable energy projects,	IDCOL, Bangladesh Bank, World Bank, IDB (Islamic Development Bank) etc.
Industries	Manufacturing of RET equipments	Rahimafrooz battery Limited, (for solar battery) Energypac (for CFL light bulb)
Implementing Organization (Private sectors and public sector)	Implementation of RET	Grameen Shakti, LGED, REB, BRAC etc.
End users (local entrepreneur and businessman, member of local community etc.)	Application of RET	Rural RET users, Local cooperative society

Source: Author's own elaboration

4.2.4. Findings from the analysis of business environment: Analysis of business environment of Bangladesh for renewable energy development uncovers some features:

1. SHS, Improve Cook Stoves (ICSs) and domestic biogas plants are best practiced small scale RETs in Bangladesh.
2. All most all the people of Bangladesh fall under BoP market in comparison with BoP income benchmark (<3000USD in local Purchasing Power Parity-PPP). Also, this BoP market has some constraints, which include lack of customers' information such as information on energy expenditure pattern, low level of knowledge and skills on RETs, poor physical infrastructure and low rate of access to financial services (savings, deposits and insurance) except microcredit.
3. Government of Bangladesh has clear goal of renewable energy development-'meet 5% of total power demand by 2015 and 10% by 2020'. After all, policy environment for renewable energy development is not satisfactory because, still they don't have any active policy framework for renewable energy planning and development. Although, government has exempted import duty from PV panel. Besides, IDCOL (Infrastructure development Company) has adapted an implementation framework for RETs. In addition they provide soft loans, grants, subsidies to partner organizations (private sectors). Moreover, they lend money to independent private sectors for renewable energy projects.
4. In Bangladesh, government is the focal point among renewable energy stakeholders by holding the position of planning, development of renewable energy. Besides, private sectors are also evolved as important stakeholder for implementing green sprouts (SHS, domestic biogas plants) with the

support of government. Moreover, RET based research organizations, industries are developing gradually in the country. But due to absence of coordinating organization, no coordination was found among renewable energy stakeholders. The business environment of Bangladesh for renewable energy is presented in the figure 4.5.

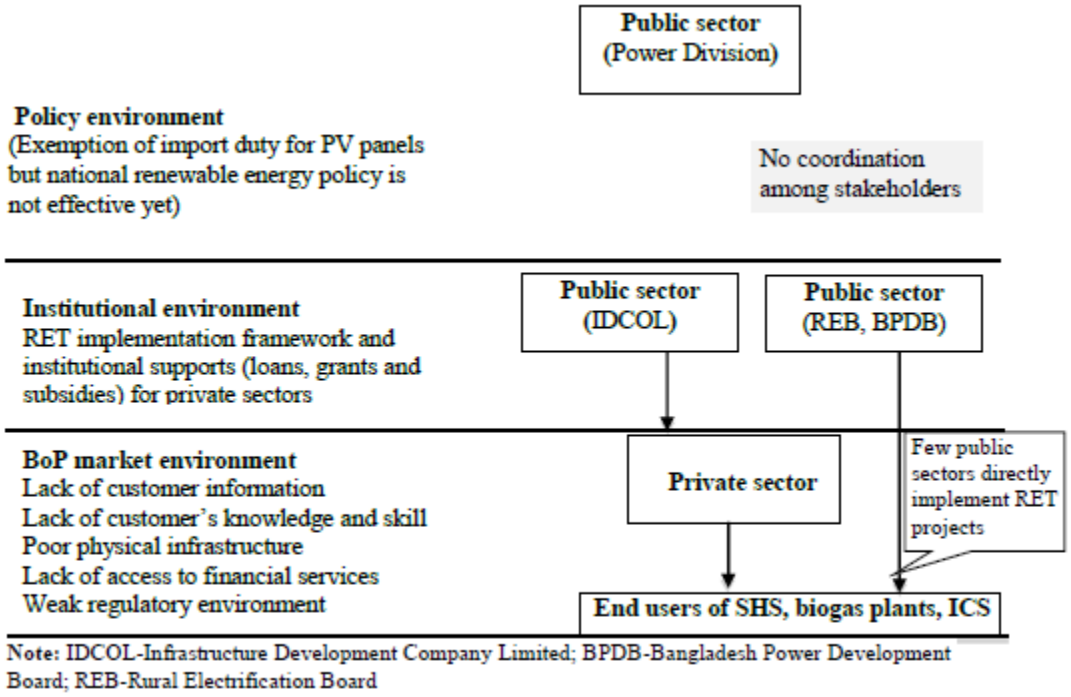

Figure 4.5: business environment for private sector in Bangladesh (Author's own elaboration)

According to the analysis market information, Government of Bangladesh has taken some measures to encourage private sectors epically such as exemption of import duty, institutional supports of IDCOL. However, some initiatives need to be taken to provide uniform business environment for private sectors such activation of renewable energy policy and establishment of independent renewable energy authority. Therefore, participation of private sector in renewable energy business still remains challenging due to identified BoP market constraints. Therefore, private sectors need to develop their market ecosystem of BoP business model in such way so that they can utilize the existing institutional and financial supports of government to overcome the constraints such as 'lack of access to financial resources'.

4.3 Business Model of Grameen Shakti (GS)

GS is one of the largest and fastest-growing rural-based renewable energy companies in the world (Grameen Shakti 2011). One of the main features that make them successful to commercialize RETs is to being able to offer microcredit to reach the poor customers. The objectives of GS are (Siddiqi 2003):

1. To popularize and deliver RETs to rural households.
2. To alleviate poverty with the provision of energy and protect the natural environment
3. To develop special credit programs for utilization of renewable energy in rural areas

At present, GS runs four different renewable energy programs: 1) solar energy, 2) biogas, 3) Improved Cook Stoves (ICSs) and 4) organic fertilizer (Islam 2011) (see table 4.7). Besides, GS is also experimenting with wind energy utilization in coastal areas of Bangladesh for exploiting it in future for rural electrification (Grameen Shakti 2011).

Table 4.7: GS's renewable energy solutions

Type of renewable energy	Technology	Total installation up to Feb, 2011
Solar energy	SHS	55,6605
Biomass energy	Biogas plant	16168
	ICS	235982
	Organic fertilizer	-

Source: Grameen Shakti, 2011

GS covers the whole of Bangladesh through the widespread network of its branch offices. Practically, it has reached the door of potential customers by branch offices located in every corner of the country. They have 1,081 branches, 145 regional and 14 divisional offices. In total, they have around 4 million beneficiaries. To run this large effort of renewable energy programs, 8,900 employees are employed in GS (Grameen Shakti 2011). The engineers working in GS are called 'Social Engineers'; because they work in the remote rural areas for providing energy services through RETs, training people and developing their skills. By their overall work they have a good intimacy not only with customers but also with rural people (Islam 2011). This author has previously studied-'Renewable energy technology and rural development: the case of Bangladesh' and found that their activities have a profound impact on social and rural development (Jonayed 2011).

Although GS has been working with several renewable energy programs, the business model of its solar (SHS) energy program will be analyzed. The following reasons have been taken into consideration for choosing the solar energy program in particular:

1. The Solar energy program of GS implements SHSs for off-grid applications. Therefore, it could be logical to investigate the SHS program to find out the compatibility with BoP business model.
2. SHSs are the most popular and widely used RET in Bangladesh and therefore highly relevant program to evaluate.
3. Besides, it is a green sprout technology as it is small scale and distributed.

In this section**,** GS's business model will be analyzed in broader perspective to explore-how the business model alleviates energy poverty. According to the outcomes of section 4.2, Bangladeshi renewable energy market represents BoP market and therefore, BoP business model could be a solution to alleviate energy poverty for BoP. Therefore, GS business model will be examined to explore business model development procedure, co-creation and native capability of the business model, market ecosystem, system of innovation for RET implementation, impacts on beneficiaries and sustainability.

Firstly, the reasons behind GS's establishment will be discussed in 'Genesis of GS' and process of establishment will be compared with 'BoP protocol' to find out whether they followed protocol or not. Secondly, GS's business model will be analyzed to examine co-creation and native capability of the business model. Thirdly, success of GS's business model for implementing SHSs will be checked in the lens of system of innovation. Fourthly, market ecosystem of the business model will be analyzed to examine-how successfully GS overcome the identified market constraints. Fifthly, impacts of GS's SHS business on customers and community will be assessed by BoP impact assessment framework. Finally, triple bottom line assessment (social, economy and environment) will evaluate the sustainability of the business.

4.3.1 Genesis of GS: In the early 1990s, there was hardly any electricity in the rural areas of Bangladesh, and most of the people at that time (as today) lived in the rural areas. This situation clicked the brain of Dr. Yunus, chairman of Grameen Bank[43] for implementing RETs in rural areas to alleviate energy poverty. Later, he contacted the Rockefeller Brothers Fund (RBF) with a proposal for installing SHSs for households on an experimental basis in January 1995. They responded warmly for helping the project of installing 20 PV panels and funded the total amount. At this stage, this was just a project of Grameen Bank led by Khalid Shams, deputy managing director of the bank. The project proved to be successful due to electricity demand of rural people for lighting, and thereby inspired Dr. Yunus to develop GS (sister concern of Grameen Bank); which literally means 'rural energy'. Later, GS was established as a non-profit company in 1996 (Grameen Shakti 2011) for delivering energy services by commercial exploitation of renewable energy in rural and remote areas of Bangladesh.

According to the genesis of GS, the way they started their business was not compatible the BoP Protocol. The BoP protocol prescribes the formation of a leadership team, field immersion team and training; identification of local partner and site selection for BoP business development (Hart 2010). However, GS made a team separate from Grameen Bank and conducted demonstration projects in selected areas. Moreover, 'co-creation' process was not ensured during the demonstration project due to considering rural people as customers only rather than partners of a co-inventing business model. Actually, they only assessed the demand of solar electricity in rural areas as mean of modern energy services. Afterwards, Grameen Bank tested their business ideas and established GS that could be comparable to 'building ecosystem' and 'enterprise creation' phase of the 'in-field' part of the BoP Protocol. However, 'embedded innovation' and 'native capability' was not achieved during the business model development of GS. It can be argued however that Grameen Bank's decade long experience of working with rural people helped to establish GS with native capability to begin with. It is notable that GS was established in 1996 while the concept of BoP came in to the scene in 2002. Therefore, it was not possible to follow the 'rule book' of BoP Protocol, though GS's business concept fits with BoP approach.

[43] For details: http://www.grameen-info.org/

4.3.2 SHS business model of GS: GS installs SHSs for the rural households under its solar energy program. Their implementation mechanism consists of marketing activities, installation of SHSs, financial packages, after sales services and training of customers. GS operates its SHS program in areas where there is no grid electricity connection but people have the ability to afford SHSs. However, they also consider poor people who have the wish to install SHSs but don't have the financial ability to purchase them in cash (Islam 2011). In such case, GS offers microcredit to customers for buying SHSs. GS receives loans as a partner organization (PO) of IDCOL and therefore becomes able to offer microcredit to end-users (Islam 2011; IDCOL 2011).

Marketing of SHS: For marketing SHSs, social engineers of GS talk with the rural people and try to inform them about the benefit of having a SHS in their house. The main points they focus to potential customers at the time of marketing include: light at night, extended education hours for children, having their own system for electricity, opportunities of entertainment purpose such as watching TV etc. If the customer shows further interest, they supply some brochures of SHSs that include information about the financial packages of SHSs, how many hours they can use them, after sales service and options for soft credit. In the next step, the customers consult with the local GS staff to select the most suitable system for his/her family depending how many electric light bulbs they will use; whether they will use other electric appliances (TV, audio player) or not, etc. (Islam, 2011). In total GS offers 11 different packages of SHSs based on the capacity of PV panel (Grameen Shakti 2011) (see appendix D of attached CD)

Sometimes, customers bring new customers. When a person talks with a neighbour who uses a SHS, the person may come to know the benefits (like lighting at night, entertainment opportunities, and increased study hours for children) of using it. That person may then also feel its importance and contact nearby GS offices for a SHS. In addition to this word-of-mouth indirect marketing, staff of GS meet with village leaders, distribute leaflets, and arrange science fairs on renewable energy technologies at local level to introduce rural people to RETs. Therefore, marketing of SHS is done by two ways: through GS and through users. In addition, goodwill due to after sales services may also influence customers to install it (Jonayed 2011).

GS also offers SHS to rural poor who cannot afford a complete SHS. In such situations, one entrepreneurially minded end user installs the system at his/her own premise with the intention to share the load with one or more neighbours. This package is named the 'Micro Utility' model. Practically, Micro utility model has become very popular in rural marketplaces. Because, it increases business turnover by extending business hours at night (Islam 2011). Up to February 2011, GS has installed over 10,000 micro utility SHSs (Grameen Shakti, 2011). Therefore, it can be argued that the Micro utility model is also an opportunity to develop a business sharing electricity among users. It can create new way of income generation.

Installation of SHSs: After finding the suitable SHS, customers complete the contractual agreement with GS. Later, GS engineers install the PV panels in a suitable place of the customer's home. Some factors are considered for installation like identifying an open place that provides enough sunshine for the PV panels, close to the home and has a south-faced horizontal orientation with a 23˚ angle to get enough sunlight (Islam 2010).

GS's after sales services: After the installation of a SHS, the customers get after sales service for 3 years. The service charge of this 'after sales services' is included with the SHS's price for 3 years. After 3 years, the customer can then make a yearly 'after sales service' agreement with GS by paying 300 Taka (3.5 USD). Customers have an option to continue this yearly agreement as per their need. In addition, a customer gets 20 years warranty for a PV panel; 5 years for the battery and 1 year for the solar charge controller and other electronics. But there is no warranty for lighting system of a SHS (Islam 2011).

GS engineers also advise clients how to take care of SHSs (battery condition, charging condition, replacement of the lamp etc.) after installation. GS ensures after sales service in two ways. First, a social engineer from GS gives a monthly visit to the customer's home for regular maintenance of the system. Secondly, GS formally trains the customers at a Grameen Technical Centre-GTC about how to take care of the system (Islam 2011).

Financial packages for SHSs: GS has developed four different financial offers for its customers. These packages are based either in cash sale or payment by monthly installments. The main features of these packages include low long payback times and reduced down payment, discounts for the cash sale and no security for a loan. If the customers pay the total price of the SHS in cash, they will get 4 % discount on the actual price. Another option is buying the SHS in 2 or 3 years installments with 6% and 8% service charge (in flat rate) respectively (Islam 2011). According to the Microcredit Regulatory Authority (MRA) of Bangladesh, a flat rate is opposed to a 'declining balance' method of interest rate calculation (MRA 2010). So, the customers in effect have to pay 12% or 24% of interest to GS for buying SHS in 2 and 3 years installments respectively.

The financial offer for the Micro Utility model is little bit different .The customers have to pay 10% of the total price as down payment. The remaining 90% of the loan amount is to be repaid by 36 monthly installments with 5% service charge, which is helpful for the poor people (Kabir et al. 2010). Currently, GS offers 40 and 50 WP SHS under micro utility model. Table 4.8 describes the method of payment for SHS.

Table 4.8: Methods of payment for SHS

Method of Payment	Down payment	Installment	Service charge (Flat rate)
Option 1	25%	24 months	6%
Option 2	15%	36 months	8%
Option 3	100% cash sell with 4% discount		
Option 4 (Micro Utility)	10%	36 months	5%

Source: Grameen Shakti 201; Kabir et al. 2010

Training programs of Grameen Technology Centre (GTC): Since 2003, GS has established 46 GTCs up to now with a motivation to train customers develop woman technicians and manufacture and repair solar accessories by trained technicians (Grameen Shakti, 2011). According to Islam (2011), half of the total population of Bangladesh is female but they are often neglected in regard education and employment opportunities. Therefore, the endeavor of GTC is to empower rural women. But also recruitment of women has some business advantages such as lower rate of salary than male, less concern than male employees etc.

GTC recruits women for rural areas with age limit between 18-30 years and educational qualification of class VIII (equivalent to standard VIII in British education system) to Higher Secondary Certificate completed (equivalent to A level). For widows, divorced and helpless women, the age limit is flexible up to 40 years. After selecting the candidate, the GTC trains 40 women in every batch for 15 days about SHSs, biogas technology and ICSs. During training, trainees also get honorium of 2 USD/day for 15 days. After completing the training period successfully, GTC selects technicians among them based on performance during training and social condition of the women. Afterwards, GTC trains them further for 7 days on manufacturing of solar charge controllers, AC-DC converters, lampshades, mobile chargers and repairing of CFL circuit repair. GTC trained women work locally for repairing SHSs. To establish them in their business, GS informs the customers about those technicians available in their locality (Islam 2011).

As a technology center, working in GTC is very challenging for two reasons. Firstly, the salary is not fixed for technician and depends on the number of items they manufacture per day (see the table 4.9). Secondly, they have to produce solar accessories as per the demand of installation of SHSs. However, a technician earns 50-57 USD/ month on average. In GTC, the day-to-day work and quality of accessories produced is monitored by the person in charge of the GTC. The person in charge of the GTC is responsible to the regional manager of GS. Besides, they also get feedback from users about the quality of accessories (Islam, 2011).

Aside from the above, GTC trains women members of each customer households on maintenance of SHSs (cleaning of solar panel, cleaning of battery, battery electrolyte checking, meaning of indicators of charge controller etc.) (Islam 2011). The main reason for choosing women is that they manage the daily household activities in Bangladesh (Barua 2007).

Table: 4.9 Daily production of a GTC

Type of accessories	Minimum production (technician /day)	Average production (technician/day)	Payment (USD/ unit of accessories)
AC-DC converter	12	15	0.15
Inverter	10	100-150	0.04
Charge controller	8	8-10	0.2
Mobile Charger	12	15	0.15
Lamp shade	25	50-80	0.1

Source: GTC, Bagerhat district, Bangladesh (during field survey by author)

Up to now GS has trained 9,291 women from GTCs. Of these, 300 women are working either with GTC for producing SHS accessories (Jonayed 2011; Grameen Shakti 2011). The initiatives of setting up GTCs help the rural woman in two ways: firstly, they provide them with training to become solar technicians and prepare them for income generating activities so that they are getting employment or business opportunities and contribute to their family. Thus the activities of GTC lead the rural women to a dignified and prosperous future (see the box 4.1). It is important to mention that produces solar accessories maintain the availability of spare parts locally and ultimately, reduce the price of SHSs (Barua et al. 2001)

Box: 4.1:

GTC has changed the life of Farida.

Name: Farida Begum
Age 30
Position: Technician, Bagerhat GTC

Farida Begum is married women with 3 children. Her husband is rickshaw (manually driven vehicle) driver. They used to live a very modest life in a village named Ronbijoypur of Bagerhat district. But a year ago she fall in deep trouble, when her husband become sick and work less due to brain hemorrhage. Farida became helpless as she was nothing but a simple house wife. She started to search job for maintaining family and medicating husband. Because, her near and close relatives were reluctant to support her. But all her efforts to get job become in vain. Because, rarely job is available for women like Farida in district level. But she got informed by her village about the provision of training and employment opportunities for poor and distressed women in GTC. She came to GTC office of Bagerhat, talked with the person In–charge of GTC and explained her family condition. She also registered her name for training. Afterwards, she got call from GTC for technician training. Afterwards, GTC and local Regional office of GS recruited her as technician considering her worse situation.

After that, Farida need not turns back. She took the responsibility of her family. She works hard in GTC, manufactures solar accessories and earns about 50 USD per month. With this amount she maintains the family, send her children to school. By this time she medicated her husband. Thus her husband returns to income. Now, she can have meal twice a day. Even, she is happier because her elder daughter wrote well in Secondary School Certificate exam and expecting the highest grade.

Source: The interview was taken during author's field visit in Bangladesh.

4.3.3 Findings from the business model: According to the analysis GS's business model, they follow the dealer-based model for SHS implementation. They sell SHSs either in cash or installment with warranty, provide soft loans to customers or ensure after sales services (repair and maintenance). In this model, after

paying the purchase price, customers own the SHS and are responsible for operating it. To make customers skilled about SHS operation, they arrange training after installing it (see the figure 4.6).

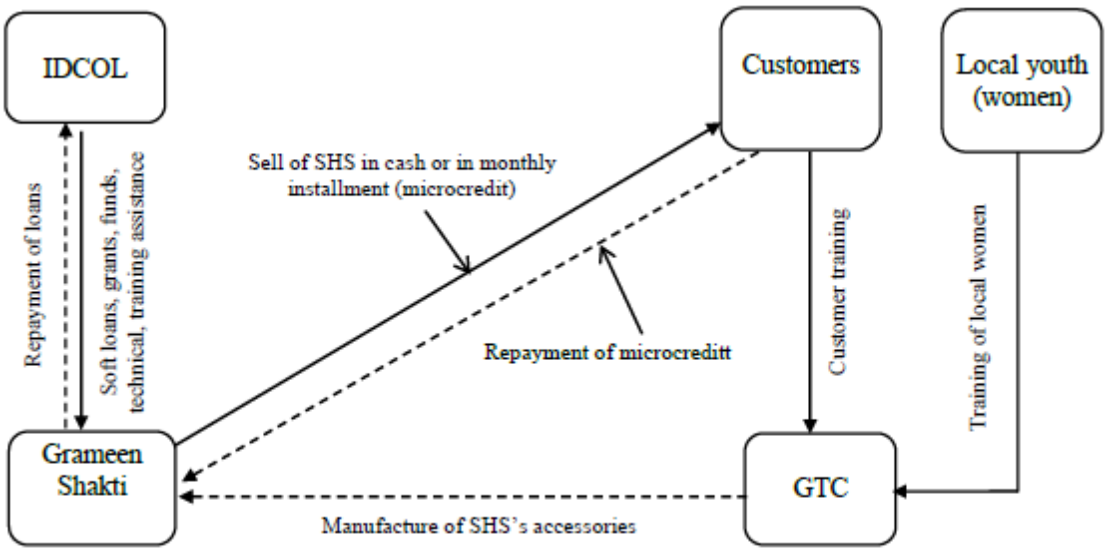

Figure 4.6: SHS business model of GS

The business model of GS possesses some features of a 'Social Business Model'. According to Yunus (2010, VII) a social business is defined as- *'... a kind of business dedicated to solving social, economic and environmental problems that have long plagued human kind- hunger, homelessness, disease, pollution, ignorance'*. This definition justifies the initiative of GS as they are working to reduce energy poverty, which is both environmental and social problem. The main proposition of social business is that the company following social business can make a profit but none can take it. The generated profit will be used to extend the business to solve social, environmental or economic problems. The owner of the company can take back the amount s/he invested but not the profit. To sustain the business, company has to believe in full cost recovery (Yunus 2010). Despite of being a non-profit company[44], GS believes in full cost recovery due to its market based approach of implementing SHSs which differs with traditional profit maximizing business by distributing soft loans to customers to make SHS affordable; which ultimately lead to alleviate energy poverty (Grameen Shakti 2011). Further, GS uses its generated profit to extend their business such as with the establishment of GTCs and solar powered computer education centers. Therefore, it can be argued that GS qualifies to meet the criterions of a social business. However, the managing director of GS denied defining their business model as social business. He argued that the total supply chain of GS is not maintaining the social business model as they import PV panel according to him, it is certain that PV manufacturing companies are not practicing social business (Jonayed 2011).

[44] A non-profit company is an organization that does not distribute its surplus funds to owners or shareholders, but instead use it to help pursue its goals.

Another positive aspect of GS's business model is trainings (customer and technician training) through GTCs. This initiative engages local people as producers and co-creators of the business. Therefore, establishment of GTCs are a turning point for GS regarding the BoP business approach. Because of this, GS is not only serving the BoP customers but also sourcing BoP products. Moreover, they are creating local entrepreneurs although it is not an integral part of their business model. So, it is arguable that after establishing the GTC, GS is co-creating business with rural people. Further, GTC helps to increase trust, confidence and acceptability in between GS and local community. Therefore, it increases the native capability of GS's business model.

Again, it could be a point of criticism that GS is receiving grants and loans from IDCOL. As BoP business based on the proposition serving the poor profitably; therefore it is logical to raise question about economic sustainability of the GS. About this issue, London and Hart (2011) argue that effective subsidies from development communities and government can help to create market and make the business economically sustainable. IDCOL funds NGOs and private companies to scale up the SHSs by reducing upfront cost with a view to full commercialization of RETs in future. Therefore, financial assistance of IDCOL could be acceptable for GS in broader perspective.

4.3.4 Users experience: Feedback from RET users is very important to find the real picture of implementation. It has been revealed from the field visit undertaken by this author that users of SHSs are enjoying many new facilities from SHS. However, some limitations are also identified from the field visit in Bangladesh. The out comes from the users[45] are described below:

The most important benefit of SHSs is bright solar light than deem kerosene light. They use solar light 3-3.5 hours every night without any interruption. Other major applications that are mentioned by the customers include: extended education hours, mobile charging, watching TV, listening to a cassette player and household activities during night. They are so satisfied with solar electricity because they don't face power cut-off like those connected to grid electricity (very common in Bangladesh). So, users can manage all activities during night within 3-4 hours of solar light. Therefore, they are committed to utilize SHSs even after hooking up with grid electricity.

Besides this, user's perception about GS is satisfactory due to their effective after sale service such as change of charge controller's fuse, fixing of problems with a switch board, checking battery electrolytes and replacement of light bulbs.

Among limitations that author was informed during field visit include irregular cleaning of solar panels. Because panels are mounted on the top of tin sheds or straw-made houses, they are therefore not easily reachable for regular cleaning. However most of the customers can check charging conditions, battery electrolytes, cleaning of battery terminals and refill of electrolytes.

[45] The author collects the information from GS's customers during field visit in Bangladesh

Most of the users interviewed use fluorescent tube light for their SHS. Application of CFL is limited due to their high price. Use of LED as lighting system was not found in the visited areas. Therefore, it may not the case for other areas.

Customer training is organized by the GTCs with the financial assistance of IDCOL (70%) and GS (30%) (Islam 2011). Typically GS provides customer training to women. This is because women are responsible for household energy management (e.g. cleaning the lanterns, refilling kerosene and lighting the kerosene lantern) (Barua 2007). However, very few women take part in customer training due to cultural and religious reasons. Based on user's experience, it can be argued that GS provides after sales service effectively and customers are also becoming familiar with skills and knowledge of SHSs gradually.

4.3.5 Success of GS SHS program: GS leads IDCOL's solar energy program in Bangladesh. GS's year wise implementation status reveals the success of its business model quantitatively (see figure 4.7). By the end of February 2011, about 833,563 SHSs have been installed in the country while GS has installed 556,605 SHSs (67% of the total SHSs) (Grameen Shakti 2011; IDCOL 2011). Since 2005, GS has showed tremendous growth in its SHS program due to the inability of the government to expand the grid electricity in rural areas. The uncertainty of grid expansion has motivated people to adopt SHSs (Jonayed 2011). Besides this, other characteristics of GS's business model have made the program successful: its ownership model[46], effective after sales services, options of soft loans and women focused program and promotional activities (Jonayed 2011).

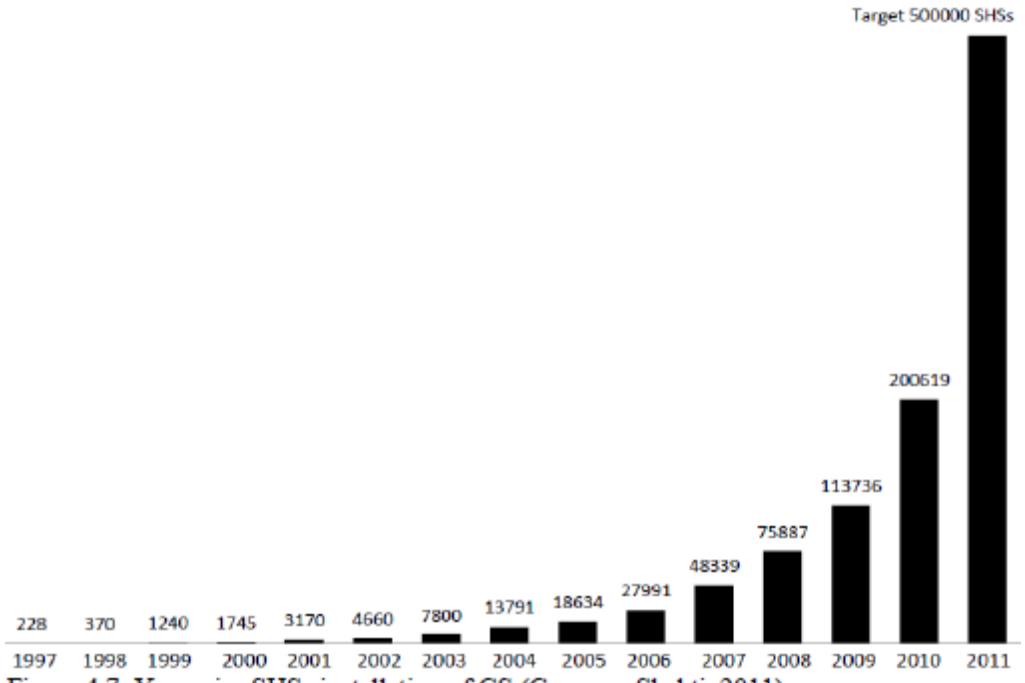

Figure 4.7: Year wise SHSs installation of GS (Grameen Shakti, 2011)

[46] SHSs are owned by the users

Again, success of GS can be analyzed through the lens of 'system of innovation' (technology; knowledge and skills; networks of actors; and institutions) which is important for successful implementation of RETs in Bangladesh, defined by Mondal et al. (2010) (see detail on system of innovation in 3.2.7). Factors responsible for successful implantation of SHS in the above context are identified and analyzed below (also see figure 4.8).

1. GS implements SHSs, which is a modern RET for rural people. Due to its rapid expansion in rural Bangladesh, it could be argued as appropriate technology. Biswas et al. (2001) defines appropriate technology as simple to use, saves resources (energy and time), increases productivity and gives comfort. SHS as a technology fulfills these criteria because the SHSs are easy and simple to use; save time and energy for users, increase productivity by generating income and employment, totally under human control, improve environment and upgrade social standards.
2. For sustainability of SHS, GS diffuses related knowledge and skills to rural people by training the clients, local youth and their own staff as social engineers. As a result, users can take care of the system, local women can develop themselves as technicians or local entrepreneur and GS staff can continue their work successfully.
3. GS has developed their network of actors with financial institutions (IDCOL) and end users to implement SHSs in rural areas. Additionally, GS is engaged in the network as renewable energy company and as service and maintenance provider of SHS.
4. GS acts as an institution that provides soft credit to make SHSs affordable for end users. At the same time they make compatible their program with local culture and traditions by adapting social acceptable business model and developing social engineers.

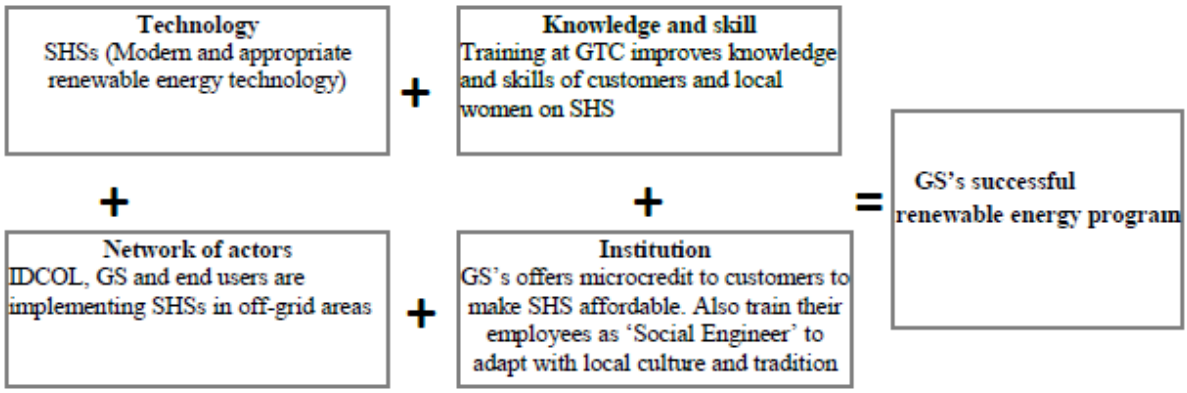

Figure 4.8: Success of GS's business model as system of innovation (author's own elaboration)

In conclusion, it can be said that GS dealer based business model for implementing SHSs is successful. The business model addresses the technology, skill and related knowledge, network of actors and institution effectively.

4.4 Evaluation of GS's SHS Business Model

In this subsection, GS's SHS business model will be evaluated based on market ecosystem, the impacts of GS's business on the ground and sustainability of the business. Firstly, market ecosystem of SHS business model will be analyzed with an intention to investigate how-successfully GS overcomes the identified market ecosystem. Secondly, BoP impact assessment framework will be used to find out the changes in economics, capabilities and relationship of customers and communities due to utilization of SHSs. Finally, triple bottom line (economy, society and environment) of GS's SHS business model will be assessed to identify the sustainability.

4.4.1 Market ecosystem of GS's SHS business model: A market ecosystem covers the interaction between market actors and market conditions. Generally, market actors mean stakeholders for a business and market conditions represents market constraints (Gradl et al. 2008). Therefore systematic understanding on stakeholders and market conditions is necessary for designing a market ecosystem for BoP business model. To design market ecosystem, Gradl et al. (2008) proposed five solutions approaches for BoP business with a view to overcome market constraints: adapting a business model, investing for enabling conditions, collaboration with communities, collaboration with other communities and collaboration with government. Now, the market ecosystem of GS's SHS business model will be analyzed below:

Access to market information is essential to operate business at the BoP market such as in rural areas of Bangladesh. GS addressed the question of market information automatically, since GS inherited this information when they grew out from Grameen Bank. Additionally, business model of GS allows for continued up keep of market information due to the large number of branch offices and social engineers that they have available to communicate with customers and rural people.

GS invests in financial and technical resources to upgrade the skills of customers and rural women. GS has established GTCs and trains customers on operation and maintenance of SHSs. They also train rural women as technicians. Therefore, it can be said that they are investing financial and technical resources solve the market constraints of lack of knowledge and skills of customers.

GS collaborates with the IDCOL (government institution) to receive grants and loans for implementing SHSs in non-electrified rural areas. Further, GS also enjoys the government provision of duty free import of PV panels for SHS. Therefore, it can be said that collaboration with IDCOL for institutional supports removes the BoP market constraints of–'weak regulatory environment' for GS.

GS offers soft loans to customers for purchasing SHSs. The option is made available by adapting SHS business model and is financed by IDCOL. Thus, the market constraints of 'lack of access financial services' is overcome by applying the two solution approaches BoP business; which include adapting business model and collaborating with IDCOL.

'After sales service' for client is integrated with business model for first three years. GS's employees visit customers at their homes for servicing the SHSs. So, customers do not need to go to GS's nearby office. Thus GS overcomes the barriers of poor physical infrastructures by adapting business model. The market ecosystem of GS's SHS business model is presented in figure 4.9.

Figure 4.9: Market ecosystem matrix for GS

		Solution approaches				
		Leverage own capabilities		Collaboration with other stakeholders		
Market constraints		GS's Business model adaptation	Investment	Off-grid communities	Organizations	Government (IDCOL)
	Market information	√		√		
	Knowledge and skill		√			
	Regulatory environment					√
	Access to financial resources	√				√
	Physical infrastructures	√				

Source: authors own elaboration based on Gradl et al. (2008)

According to market ecosystem analysis, GS has adapted a business model for installing SHSs by investing resources and collaborating with government and communities to solve the market constraints. In GS's SHS business model, all market actors (local communities and IDCOL) play a strong role in their market ecosystem to overcome the constraints through explaining why GS's SHS business model has become successful. Collaboration between GS, end-users (communities) and IDCOL has made market condition favorable towards commercialization of SHSs by the private sector.

4.4.2 BoP impact assessment of GS's SHS business: GS's SHS business model is serving the BoP with a motive to alleviation energy poverty in a market based approach. So, GS's SHS program needs to be assessed to find out the impact of the business on the ground. London (2009) has developed a BoP impact assessment framework; which assesses the changes in economics, capabilities and relationships among customers, sellers and communities due to BoP business intervention (see section 3.2.7 for detail) This is opposed to analyzing the target achieved or quantity of products distributed or money spent in the BoP business. The impacts of the GS's SHS program are assessed below based on the BoP impact assessment framework.

Changes in economics: Changes in the economic perspective cover gains or losses in income, assets, liabilities etc. BoP impact assessment of GS's business has realized the following changes in income, assets and liabilities among customers and communities.

1. Due to having a SHS, users get electricity in a competitive price. Because SHSs have very low or no externalities (environmental cost, health cost, etc.) (NERP, 2008). In addition the price of solar

electricity is argued to remain cheap in the long term due to no fuel cost and gradual decrease of price of PV technology as well as the increased price of petroleum (Mondal and Denich 2010; EIA 2010)

2. GS certified technicians can be employed either in GTCs for manufacturing solar accessories or in GS as repair and maintenance technicians.
3. In rural marketplaces, solar light increases business hours at night and generates extra income. This kind of use can be seen in grocery shops, tailoring shops, tea stalls, barber's shop etc.
4. Grameen Bank offers cellular phones under 'Polli Phone Scheme' to rural women for mobile call business. Grameen Bank applies microcredit to sell the phone to women. Woman in non-electrified areas take 'Polli Phone' with SHS for recharging the mobile battery and therefore, start business. This approach proves successful and provides self-employment opportunities in rural areas.
5. Under solar light, members of household can utilize their leisure time by basket making, net weaving, tailoring etc.
6. Expansion of SHS creates new job opportunities for communities. By the year 2015; 100000 green job will be created (Grameen Shakti 2011).

Changes in Capabilities: In BoP impact assessment, changes in capabilities investigate influence on health, skills, confidence of individuals and communities needed to help themselves. Following changes in capabilities are realized among customers of GS and communities.

1. After having SHS, children can read better in solar light than kerosene lantern, and have the possibility of extending study hours.
2. Rural people can watch TV using SHSs and thereby get access to educational programs and entertainment as well, which helps building awareness and providing a source of enjoyment respectively.
3. Training of women by GS helps to create employment opportunities and assists women empowerment.
4. Women need not bother with lighting and cleaning of kerosene lamps every night. It also saves the time of buying fuel (eg. kerosene) or charging batteries from distant places.

Changes in relationships: In BoP impact assessment frame work, changes in relationship assesses whether BoP business provides access to networks and partnership; and reduce social exclusion; and geographic isolation or not. Following changes in relationship are realized among customers of GS and communities.

1. It could be argued that having SHSs could impact on social relations. Installing SHSs builds a social relation and network between GS and customers. When customers buy the system on installment, trust grows between them providing that the installments are paid on time. GS's monthly after sales services increase confidence to the customers to use SHSs.
2. Having a SHS in non-electrified villages increases the social status of the customers.

3. SHSs bring new roles for women in household work and in income generation by accessing GTC's or GS's employment opportunities.
4. Watching TV using solar electricity brings rural people together at leisure time and increases social cohesion.
5. Individuals and communities' relationship with ecosystems increases as solar energy is renewable, environment friendly and moreover, reduces CO_2 emission (Kabir et. al. 2010).
6. GS's SHS business model may cause social exclusion when women can-not take part it customers training in GTC due to cultural and religious barriers. Finally, the realized impacts of GS BoP business are presented in the table 4.10.

Table 4.10: Impact assessment of GS's BoP business

Customers	Communities
Realized changes in Economics	
2. Electricity in competitive price 3. Increase productivity 4. Income generation 5. Access to credit	1. Employment opportunities 2. Economic development
Realized changes in capabilities	
1. Educational development 2. Knowledge and skill development for women 3. Entertainment opportunities 4. Improvement of living standards 5. Ability to use local resources	1. Increase of awareness and perception on improved energy services 2. Social development
Realized changes in relationships	
1. Build new social network (GS-customers) 2. Building confidence and trust 3. Increase social status	1. Increased social network 2. Increased gender equity 3. Increased relation with ecosystem 4. Risk of social exclusion

Source: Author's own elaboration

The BoP impact assessment of GS's business model reveals that changes in economics, capabilities and relationship take places among end users and communities through implementation of SHSs. The changes identified are positive, though negative changes could take place. However, no critical negative changes are identified through analysis. Major economic changes of users that BoP assessment framework found are electricity in competitive price, income generation and employment opportunities. In broader sense, community people get rid of energy poverty through the implementation of SHSs. Also changes in capabilities and relationship are observed such as development of skill and knowledge, building of social network among GS and users. But it could be argued that change in economy is most important as people are getting solar electricity instead of kerosene light in affordable price.

4.4.3 Sustainability assessment of GS SHS business model: Motivation to establish and operate a business venture at BoP is not enough to make the business sustainable (Hart 2010). To make it truly sustainable, effects of entire business system on environment, economy and society should be analyzed which ultimately encourages a positive the triple bottom line (economy, environment and society) assessment. In addition, Hart (2010, 191) claims that 'The problems that a sustainable global enterprise solves should, of course, be more significant than the new ones it creates'.

GS installs SHSs among the rural people of Bangladesh in a market-based approach and can be argued to be a successful one due rapid scaling up of business. Therefore, it is imperative to assess the sustainability of the business including negative and positive impacts.

The application of SHSs has some positive impacts on customers and rural communities. Firstly, they get solar electricity in competitive price. Because, Komatsu et al. (2010) reported that use of SHS reduce monthly energy expenditure by 20%-30% and eliminate transport cost of kerosene. Also, it can increase productivity of users, generate income in rural business and create employment opportunities for rural women. However, it could be argued that application of SHSs in rural households can raise some problems. For example, village shops that sell kerosene will lose profit due to SHSs. Notably, village grocery shops not only sell kerosene but also many other items. Also, repayment of loan may reduce the monthly budget for basic needs. Further, failure to repayment may create loan defaulter and hamper the relationship between GS and customers. Also, it is necessary to mention that SHS business of GS is subsidized. Therefore, when this subsidy will be phase out in future, it may reduce the affordability of the poor customers.

Some positive social impacts can be identified due to GS's solar energy program such as health improvement, more time to study for children, entertainment opportunities by watching TV, rise of social status for SHS users, women empowerment, security of women at night and the increase of social communication by using mobile phone. But, it can be said that the use of SHS may create mental conflict in between SHS and kerosene lantern users, if enjoyment of solar light is considered to be a symbol of social status.

As RETs are environmentally friendly, the implementation of SHSs has positive impacts on the environment. It reduces the use of kerosene for lighting, which ultimately cuts the CO_2 emission and reduction of indoor air pollution. Besides this, GS distributes plants in reduced price to the customers of SHSs and takes over the maintenance. But, SHSs could create some environmental problems also. There is no facility available in Bangladesh to recycle the old panel. In this regard, Caster (2011) reported that that recycling of PV panel is energy intensive and able to create health hazards. Further, old solar batteries are not environment friendly. The type of battery GS uses for SHSs contains lead and acid and is therefore harmful to health and the environment (Morrow 2001). Although GS collects old batteries, refunds money to customers for old battery and sends collected batteries to recycling plants of battery manufactures. Again use of CFL could cause mercury pollution and need to be disposed of safely (World Bank 2008). Therefore, it can be argued that

massive use of SHSs in rural areas could raise some environmental problems such as electronic waste pollution; which need to be taken in to consider in coming days. However, Gomm (2011) claimed that PV panels have a longer lifetime (20-25 years) than batteries (5 years). Therefore, they are more concerned about battery pollution. However, he mentioned that currently, there is no initiative in Bangladesh to manage the old or decayed PV panel. Figure 4.8 represents the results of sustainability assessment of GS's SHS business.

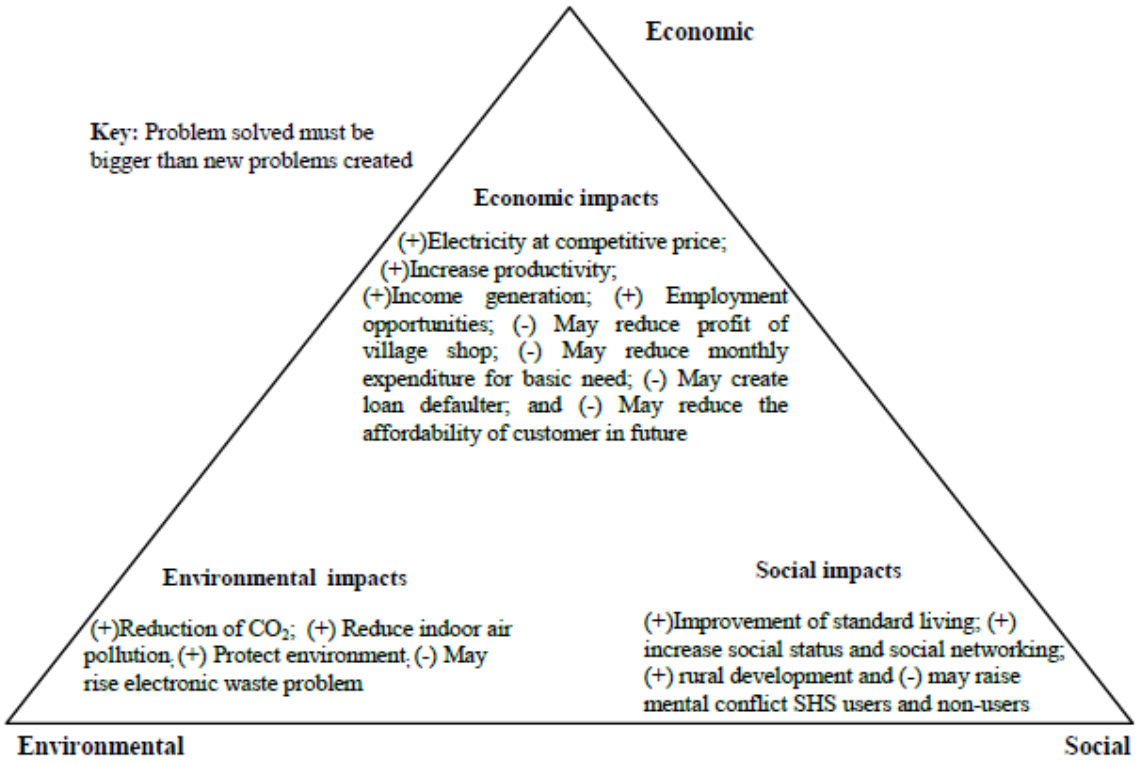

Figure 4.10: Sustainability of GS's SHS business

The triple bottom line assessment of GS's business model reveals significant positive economic, social and environment impacts to the end users and communities. So it can be argued that the business model serve BoP in a sustainable way which means that total positive impacts of business intervention are greater than negative impacts. However the negative impacts identified in the analysis are possibilities. Therefore, it can be said that BoP business chain of GS is socially, environmentally and economically sustainable.

4.5 Chapter Findings

According the analysis of market information, renewable energy market of Bangladesh represents BoP market which consists of some market constraints which include lack of customer information; lack of customer's knowledge and skills; lack of access to financial (except microcredit) resources; weak regulatory environment and poor physical infrastructure. In such a market, GS has been operating their dealer based SHS business model for alleviating energy poverty. In the business model, customers can purchase SHSs (either in cash or microcredit) with after sales services. Further, the establishment of GTCs not only ensures the availability of spare parts locally but also trains customers and local women (as technicians). Thus, BoP

people get solar light at affordable prices and GS makes profit through business intervention, which supports the BoP concept. Though GS did not follow the BoP protocol during the formation of business model, they have achieved the native capability and secured the co-creation of business with local communities by launching GTCs. Addition, GS has developed a suitable market ecosystem for their SHS business model that can solve all the identified market constraints applying different BoP solution approaches such as investing resources for crating enabling environment for business, collaborating with communities and government institution (Infrastructure Development Company Limited). Also, the dealer based business model for implementing SHS is successful to be a system of innovation as because it addresses technology, related knowledge and skills, network of actors and institution fruitfully. Further, the assessment of the BoP business of GS confirms that it brings changes in economic, capabilities and relationship of the communities and end users. Not only that, but the business chain of GS is also sustainable socially, economically and environmentally where the total positive impacts are more significant than negative impacts. In addition, the application of SHSs in off grid areas can be argued to be a sustainable part of rural development. This is because it is economically affordable, politically acceptable and technical know-how is adaptable to local people and thereby leads to a new standard of living in rural Bangladesh.

At the end, it can be said that SHS business model of GS owns the characteristics of fortune creating 2nd generation BoP business model by ensuring the co-creation and native capability. Also, BoP business model of GS has proven as successful initiative due to effective development of market ecosystem and ensuring sustainability socially, economically and environmentally.

5. Business Model of Sunlabob Renewable Energy

5.1. Introduction

In broad sense, this chapter deals with business model of Sunlabob Renewable Energy Limited (Sunlabob) in two ways. Firstly, market information related to renewable energy sector of Lao PDR will be analyzed to identify the opportunities for private sectors. Secondly, business model of Sunlabob will be also investigated to find out how they are alleviating energy poverty through their business intervention.

5.2. Business Environment for Renewable Energy in Lao PDR

In this section, different aspects renewable energy business such as renewable technology practice and market information will be discussed with an aim to find out bet practiced renewable energy technologies (RETs), existing business opportunities for private sectors and market constraints. The outcomes of this section will be applied to evaluate the business model of Sunlabob.

5.2.1 RET practices in Laos: RETs used by Laotian people include: SHS, solar mini grid, community PV, micro hydropower, Pico Hydro Power (PHP) and small-scale biogas plant (Smits 2011a; Phomsoupha 2011). The analysis of these RETs will give a clear picture of best practiced technologies in the country.

Solar home system (SHS): Among available PV (Photo voltaic) technologies[47] in Lao PDR, SHS is most popular technology at household level and accounts the major part of PV installations (Susanto and Smits 2010). The reasons behind popularity include: locally available resources (solar radiation) to run SHS, modern technology to produce electricity, user friendliness. Smits (2010) also pointed out the subsidies of World Bank and grants from donor agencies (eg. Japan International Agency for Cooperation-JICA) as a cause of popularity (Susanto and Smits 2010).

SHSs were first implemented in Lao PDR by World Bank supported project-'Southern Provinces Rural Electrification- SPRE' from 1998 to 2004. This project brought 4910 off-grid households under solar electricity. Later, 'Rural Electrification Project, Phase-1 (2006-2010)' of World Bank covered 9000 households under SHSs. Phase-2 (2010-2013) of the same project has targeted of installing another 10000 SHSs (Bambawale et al. 2011). In private sector, Sunlabob Renewable Energy (Sunlabob) has installed more than 5000 SHSs (Sunlabob 2011a). Up to now, more than 15000 SHS set up by the combining the efforts of public and private sectors (Susanto and Smits 2010).

Solar PV based mini-grids: It is mainly named as Hybrid Village Grid; where electricity is generated by using renewable and non-renewable resources such as solar energy, hydro power, wind energy, diesel generators etc. In this type of grid, solar PV system is used at daytime, hydro at night and diesel generators as backup system (Sunlabob 2011a). There are three solar PV mini-grids in the Lao PDR located in Oudomxay, Luang Prabang and Xiengkhouang provinces, all of which were funded by official development assistance grants (Susanto and Smits 2010).

[47] SHS, solar mini grid and community PV

Community PV: In this case, PVs are installed to provide electricity for storing vaccines and medicines; and lighting schools, health centers, community centre etc. (Sunlabob 2011a). There are over 1,000 community PV systems installed in Lao PDR, mainly installed as part of larger rural development projects (Susanto and Smits, 2010) (Sunlabob 2011a)

Micro-hydropower: River water is channeled to a settling basin and later water flows into the fore bay tank where it is directed downhill through a pipe called a penstock. When the water reaches the bottom, it drives a turbine to produce the electricity (Practical Action, no year). Micro-hydropower generates hydro-electricity with a rated capacity in between 5 to 100kW (Susanto and smits 2010). In total, 31 micro hydropower plants were constructed in the Lao PDR, of which only 9 are currently operational (Department of Electricity 2009). Reasons behind massive failure to operate micro hydro include: lack of local capacity for operation and maintenance, low availability of spare parts and lack of ownership (Susanto and Smits 2010; Smits 2010)

Pico hydro power (PHP): PHP is defined as hydro-electricity generation with a rated capacity of under 5kW (Susanto and Smits 2010). The PHP system consists of intake from stream or river, pipe[48], water turbine, electrical generator, electronic controller, electrical distribution system (Pico hydro website, no year) (see figure 5.1). Although, different types (low head, turgo head etc) PHP units are available, the low head type is mostly used in Lao PDR as it requires small head of 1.5m and water flow rate of 35 liter/second. The flowing water falls on the propeller, turns the shaft, and generates AC (Alternative Current) current at alternator. Turgo type PHP is less available as it requires water head of several meters (Smits and Bush 2010).

PHP is widely used in the Lao PDR to supply electricity to individual or groups of households. However, the turbines used in Lao PDR have a range of installed capacity such as 300W, 500W and 1000W. A rich diversity of installation practices is found in different provinces and even within a village. The installation techniques of the turbines vary from 'textbook' to locally adapted procedure (Smits 2010).

Figure 5.1: Pico Hydro Power (PHP) system (source: http://www.lao-ire.org/)

[48]known as the penstock

Businessmen and traders from China and Vietnam cross the borders and sell cheap PHP turbines to shopkeepers of major provincial markets and then, shopkeepers sell the units directly to the end-users (Susanto and Smits 2010). Also it is noteworthy that PHP doesn't enjoy any subsidy like SHS and therefore total supply chain is market oriented (Smits 2010; Susanto and Smits 2010; Smits and Bush 2010). According to estimation of Susanto and Smits (2010), over 60000 PHP are installed in Lao PDR and most of them are utilized by the off-grid people of mountainous and hilly Northern provinces[49]. Further, Theuambounmy, (2007) reported that more that 50% of households of north-eastern villages of the country use PHP.

PHP is very popular in off-grid Laotian because of low price and operation cost comparing other off grid technologies such as wind mill, SHS, diesel generators. Additionally, good availability of separate part and low complexity of technology make PHP favorable to end-users (Susanto and Smits 2010). Inspite of huge popularity in off grid areas, PHP has some problem: it is not equipped with any form of automatic load control. Therefore, fluctuation in river water flow destabilizes the voltage out-put and cause blowing of light bulbs, and damage of TV and sound systems. Thus it substantially increases the cost of operation and maintenance of PHP system (Smits 2010).

Biogas technology: Biogas technology is practiced in Lao PDR to produce clean cooking energy (Susanto and Smits 2010). The biogas plants that are being used can be characterized as small due to size of the digester ranges from $4m^3$, $6m^3$, $8m^3$ to $10m^3$ (Lao Biogas Pilot Program, no year). Currently, Lao Ministry of Agriculture and the Netherlands Development Organization (SNV) have launched a joint program named, Lao Biogas Pilot Program (BPP). Under the program, each biogas plant of above-mentioned size receives a subsidy (33% cost of a biogas plant construction) (Theuambounmy 2007). Excluding subsidy, the construction cost of biogas plant ranges from 200-400USD. Up to July, 2010, more than 1,510 biogas plants have been constructed in Vientiane capital, Savannakhet, Xiengkhoung, Khammoune and Vientiane provinces (Laos Biogas Pilot Program 2011).

5.2.2 Best practiced RETs in Lao PDR: In addition, some authors such as Theuambounmy, (2007) and PREGA (2007) reported the potential of wind energy in Lao PDR; particularly in south central provinces (Bolikhamxay, Khammouane, Savannakhet and Saravan) of the country. However, Smits (2011) claims that any wind energy technology has not utilized yet in Lao. Therefore, the analysis of RETs it can be argued that SHS and PHP constitute the best practiced RETs in Lao PDR (see table 5.1). But Smits (2011) claimed the popularity of PHPs over SHSs due to cheap in price even without any subsidy, easy installation and operation. Contrary, Phomsoupha (2011) criticized the application of PHP due to very low quality (of technology) and durability (approximately 1 year). Smits (2011) mentioned other difficulties of using PHP such as variation of seasonal stream flow and unavailability of streams. In case of SHSs, user-friendliness, availability of sunshine in everywhere of Lao and subsidy make the technology popular among people

[49] Northern provinces include Phongsaly, Houaphan, Xiengkhouang, Bokeo, Luangnamtha, Oudomxay and Sayaboulli

(Schroeter 2011; Smits 2011). Thus, SHS could be argued as best practiced RET than PHP. However, other RETs like micro hydro, biogas technology can-not be counted as best practice due to some practical problems noted above.

Table 5.1: Best practiced RETs in Lao PDR

Renewable sources	RETs	Total installations	Installed capacity
Solar energy	SHS	± 16000	297 kW
	Solar PV mini grid	3	-
	PV community	1000	-
Hydropower	Micro hydro	±30	454 kW
	PHP	±60000	-
Biomass energy	Biogas technology	1510	-

Source: Smits and Bush 2010; Smits 2010; Susanto and Smits 2010; Laos Biogas Pilot program 2011

5.2.3Market information: In this sub-section, market information for renewable energy business will be presented in different headings: customer information, financial services, physical infrastructures, regulatory environment and stakeholders. The intention behind this analysis is find out the market constraints of renewable energy market of Lao PDR; which is very important for developing market ecosystem of a business model. Besides, it will also give ideas to private sectors about the market opportunities for renewable energy business in existing market condition. The market information will be presented below.

Consumer information: The country has a population about 6.5 million; and out of them, 30.9% of population live in the urban areas and rest of them reside in rural parts (ADB 2009c; World Development Indicator 2011; Smits 2011a). Per capita income of the country accounts 880 USD (in 2009), which characterize the country as developing one where 44% of people stay under poverty line[50] (World Development Indicator 2011; ADB, 2010). There are about 952000 households (in 2005) in 18 provinces of the country and except capital city, most people are related to farming activities (agriculture and livestock's) (Lao Statistics Bureau 2005). More specifically, agricultural labours constitute about 76% of the total labour force (FAO 2006). Thus, Lao PDR can be defined as agricultural country.

Any statistics regarding household/individual income and expenditure was not found that could be used to define the BoP market of Lao. Based on the per capita income (880 USD) of Lao people, whole population fall under BoP market. Because, BoP defines those people with per capita income are less that 3000 USD annually in local PPP (Hammond et al. 2007). However, some people in Lao PDR have income above BoP benchmark. Further, the extent and existence of BoP market is also indicated by size of population living below poverty line.

Adult literacy rate of Lao is gradually increasing. The literacy rate of the country was 60%, 70%, 73% and 84% in 1995, 2000, 2005 and 2007 respectively; which indicates the gradual increase of education level among people (World Development Indicator 2011). In addition the net primary school enrollment was

[50] Bellow 1.25 USD/ day benchmark

86.3% in 2007 (ADB 2010). However, these data don't provide clear idea about knowledge and skill level of BoP people. Though, it can be argued that knowledge and skill level could be related to education level. Hanshel et al. (2010), Schroeter (2009) and Smits (2011a) reported that the skill and knowledge level of Laotian is relatively low due to back dated education system, low rate of literacy, and lack of familiarity with technology. Reversely, Smits (2010) mentioned that about 22% of total Lao villages (equal to 10473 villages) use PHP for electricity and the system are generally repaired and maintained by end users. Therefore, it can be concluded from Smits (2010) that a portion of Laotian have some knowledge and skill on RETs, but vary due to literacy, technology use etc.

Financial services: Financial services (savings, deposit, credit and insurances) are very important for increase income, developing business venture and prevent economic shock throughout the life (Bank of Lao PDR 2003). In Lao PDR, people receive financial services (savings, credit and deposit) by 21 public and private banks (Bank of Lao PDR 2009). But Phomsoupha (2011) claimed that except ANZ Grindlays Bank, commercial loans for renewable energy projects are limited.

In Lao PDR, only international NGOs are entitled to provide to micro credit. But, very few are operating the service to poor due to very limited knowledge about best practices of microfinance (ARCM 2011). On the other hand, GoL (Government of Lao) approved establishment of local NGOs since May 11, 2009 (IRIN 2009). Therefore, they are new in the field of microcredit. However, any information about consumer financing services for RETs has not been found. Besides, 10 companies do insurance (general and life) business in Lao (Lao PDR Yellow Pages 2011). However, the Bank of Lao PDR (2003) reported the weakness of financial services to reach the people. According to the report, more than 28 % of Laotian (in 2003) are poor and only 7% have access to financial services. Therefore, Access to financial services is still a market constraint for rural people.

Physical infrastructure: Physical infrastructure is important to connect the isolated villages and thus contributes to income and employment opportunities of people. Lao PDR has a road network of 7000 km including the length of bridges, which only provide access to two-thirds of population to all season roads (William 2007; World Bank 2011). More clearly, 14% of the road network is paved and typically represent the urban part of Lao (World Development Indicator 2011; Lao Statistics Bureau 2005). But for rural areas situation is not satisfactory at all because, about 40% of total villages do not have proper road and therefore facing severe problem of communication (Wlliam 2007). Mountainous terrain of Lao PDR could be one reason for unsatisfactory road network. In case of telecommunication, only 33% of population subscribes cellular phone while 8.5% of population uses internet services (World Development Indicator 2011). Therefore, unsatisfactory physical infrastructure of Lao keeps people away from improved products and services. Specially, non-accessibility to road network increases the transaction cost of the products and services and finally rural poor have to face poverty penalty.

Regulatory environment: Under this heading, policies related to renewable energy development of Lao PDR will be discussed primarily with an intention to identify government's existing support for developing renewable energy and encouraging private sectors. Secondly, institutional support for RET implementation will be discussed to identify the scope of private sectors. Finally, under the sub-heading of 'stakeholders of the renewable energy sectors', different stakeholder's (public and private sectors) will be analyzed to find out their role in renewable energy development.

I. Policy support

Power sector development goal: Power sector of GoL has goal of electrifying 90% of households by the year 2020 (Smits and Bush 2010; Powering Progress 2011; Susanto and Smits 2010). To attain this target, power sector of Lao PDR has been moving steadily with a gradual expansion of household's electrification: 16% in 1995; 38% in 2003 and 70% in 2010 (Theuambounmy no year). Besides, GoL expects that 10% of households of 2020 level would be electrified by off-grid electrification system such as SHS, community PV system, micro hydro, PHP, village hybrid grid (solar, hydro, wind and generators) etc. (Susanto and Smits 2010). Therefore, off-grid electrification target of 2020 will be achieved by RETs excluding the very little contribution of diesel generators (Smits and Bush 2010). GoL allows private sector to establish small-scale (up to 50 kW) renewable energy based power generation. For that type of energy projects they offer tax, import duty and export duty exemption[51]. Also, they are planning to establish rural electrification fund; which is under consultation, which would support small-scale renewable based power generation in rural areas (Phomsoupha 2011). Thus, reliable and affordable supply from on and off-grid system will contribute to socio-economic development of the people and thus help to attain the vision-2020 to be 'free from LCDs (Least Develop Countries)' (NGPES no year).

The Law on Electricity (TLE), 1997*:* The GoL has enacted their TLE (The law on Electricity) in 1997 to administer the electricity production transmission, distribution and export so that it can contribute to socio-economic development of the country by upgrading the living standard of the people. The provision of renewable energy implementation under TLE (1997) is discussed below.

TLE (1997) admits the rural electrification using renewable energy such as solar energy and hydropower in those places that are not feasible to connect with grid electricity (Article 38). According to article 9 of TLE (1997) Electrification projects are handled and approved by more than 50 MW, 50 MW to more than 2 MW, 2000kW to more than 100kW and less than 100kW are approved by national assembly, GoL, Provincial Department of Energy and Mines (PDEM) and district level administration respectively. Article 41 of TLE (1997) facilitates the establishment of 'off-grid rural electrification fund'. At present, rural electrification fund has been developed with financial assistance of World Bank. However, the sources of the fund could be channeled from state budget, people, domestic assistance, foreign assistance etc. Beside, Government can also reduce or exempt import duties and can provide credit or loan for equipment, construction and

[51] 10% personal tax for foreign employees of foreign enterprise, exemption of profit tax for first 7 years and afterwards 10% profit tax

installment. Therefore, it can be argued that renewable energy is considered as alternative solution of grid electricity in TLE. But, article 9 of the law facilitates the participation of private sector in renewable energy based rural electrification by providing legal procedure of RET implementation.

Drafted National Renewable Energy Development Strategy (2010): The Government of Lao PDR (GoL) encourages the development and promotion of renewable energy as a mean of economic development by ensuring energy security, improving socio-economic development, and enhancing environmental and social sustainability. However, Lao PDR is delayed in comparison with other ASEAN (Association of South East Asian Nations) countries for developing renewable energy sector due to lack of related policies, laws, regulation, institutional coordination, public fund constraints, knowledge gap etc. The country has drafted National Renewable Energy Development Strategy (NREDS)-2010 as priority policy, aiming to consider those renewable energies (solar, small hydropower, wind, biogas, bio-fuel), which are not utilized yet (NREDS 2010). The main target of drafted NREDS (2010) is to achieve 30% share of renewable energy in total energy consumption by the year 2025. To attain the target some initiatives will be taken: promotion of renewable energy, formulation of new renewable energy laws and regulations; and provision of financial incentives for investors of RET projects. Drafted NREDS (2010) provides promotion and development strategies for every single renewable energy sources suitable for Lao by identifying the areas of application. Only solar energy development and promotion strategies will be discussed due to its relevancy with current research work.

According to drafted NREDS (2010), solar energy development and promotion encompasses implementation of SHS for lighting services in remote and rural areas, support solar energy business in off-grid areas, utilization of solar heating for households and commercial purposes and productive application of solar energy such as solar water pumping for drinking and irrigation purpose. As implementation strategy of SHSs, government applies 'hire purchase system' in SHS projects at rural areas. Besides, large-scale building integrated PV technology for grid electricity and hybrid PV system for off-grid areas are also consider for solar energy development and promotion. In this regards, information dissemination about the technologies, training programs, business model development, demonstration projects, encourage private sector would be the strategies.

Drafted NREDS (2010) invites the participation of private sector in renewable energy projects for generating power. It could be either for national grid or off grid areas or small-scale power generation. In order to invite private sector, government will provide incentives according to the Law on Promotion of Foreign Investment (2004) such as exemption (0%) of import duties, low personal tax (10%) and profit tax[52], long term investment contract (75 years), provision of hiring foreign experts (10% enterprise labour). In addition, government will manage financial assistance from commercial banks and international organizations for renewable energy projects. Further, some financial incentives are recommended in drafted NREDS (2010) to consumers and entrepreneurs such as subsidized SHSs, ICSs and biogas plants, low interest credits and

[52] 10-20% depends on the area and size of investment

loans, and services delivery scheme to reduce upfront cost. Further, 'Renewable Energy Fund' as a part of 'Rural Electrification Fund' will be developed for financing renewable energy projects, disseminating knowledge and building capacity on renewable energies (NREDS 2010)

It can be said that the drafted NREDS (2010) is a good attempt to plan, develop and implement renewable energy in Lao PDR. Because, it has a time frame and a set of objectives to utilize renewable energy for power production. Moreover, separate strategy for each potential renewable energy source makes the drafted NREDS more effective than outlining overall strategies. Besides, it also encourages private for renewable energy projects by offering incentives and financial assistance. Finally, a plan to establish separate agency for renewable energy development in long term makes the strategy more robust. Inspite of having renewable energy source specific strategy and implementation mechanisms, some limitations can be identified from drafted NREDS. Firstly, there is no time limit for setting up independent renewable energy agency. Secondly, addition of energy efficiency could be imperative as the country does not have any energy efficiency law or acts (PREGA 2007). However, to attain sustainable energy solution, implication of energy efficiency in demand side is as important as renewable energy implementation and efficiency improvement in energy production, which is undermined here. Thirdly, the drafted NREDS (2010) admits the renewable energy based electricity production for national grid which demands the formulation of 'feed-in–tariff'. But this strategy only recommends the change in electricity tariff in future than feed-in–tariff. Fourthly, there is no incentive for promoting RET manufacturing industries. Although, due to these short falls, Smits (2010) criticized the drafted NREDS (2010)-'……..*the renewable energy strategy was not convincing at all and ……..they (government) didn't come up with clear policies*'. However, it can be concluded that strategy is drafted only and not effective yet. Therefore, it could be possible to remove the drawbacks to make it more effective for developing renewable energies. According to Phomsoupha (2011), one possible solution could be sharing and consulting with renewable energy stakeholders before approving by the parliament.

Outcomes of policy analysis*:* GoL has a clear goal of connecting 10% of the households with electricity services by the end of 2020 and utilize renewable energy so that it can contribute 30% of energy consumption within 2025. Prior to draft NREDS (2010), there were no clear policies, laws and regulations for development of renewable energies. Only TLE (1997) considers renewable energy for off-grid electrification including the legal procedures for approval, installation and operation of off-grid system for private enterprises. Afterwards, drafted NREDS (2010) has formulated detail promotion and development strategies for renewable energies, offer incentives for private sectors and developed institutional arrangements. Moreover, this strategy treats renewable energy as source of power generation for both on-grid and off-grid people realizing its great potentials. Therefore it can be concluded that GoL has gradually emphasized on the development and utilization of renewable energy and also invited private sectors for commercializing RETs (see table 5.2).

Table 5.2: issues of renewable energy development and privates sector participation in different policies and planning

		Issues addressed about renewable energy and business opportunities for private sector
Policies and Goals	Goals of power sector	1. 10% of households at 2020 level will be electrified by off grid electrification systems 2. Recognition of RETs as a mean of off grid electrification
	TLE (1997)	1. Rural electrification by RETs 2. Legal procedures of RET based electrification 3. Provision of private sector in off grid electrification
	Draft NREDS (2010)	1. Utilization of renewable energy for improving socio economic condition of people 2. Target oriented renewable energy development 3. Renewable energy specific promotion and development strategies 4. Institutional arrangement for renewable energy development 5. Encouragement for private sector by providing financial assistance and other incentives.

Source: Author's own elaboration

II. Institutional support

Ministry of Energy and Mines (MEM) on behalf of government of Lao PDR implements SHS in off-grid areas under rural electrification program funded by World Bank (Bambawale et al. 2011). Generally, ministry of energy and mines administers the electrification in Laos. But, MEM did not have the institutional capacity to execute RETs programs. So, a French company, IED (Innovation Energie Developpement) was assigned in december, 2006 to implement RETs in non-electrified areas. Under the supervision of Innovation Energie Developpement, Village Off-grid Program and Support (VOPS) office was established in 2006 to recruit, train and manage Provincial Energy Supply Companies (PESCOs) (VOPS 2011)**.** Later the village off-grid program and support is taken over by Ministry of Energy and Mines after the phase out of contract with Innovation Energie Developpement in december, 2009[53] (Simts 2011a; Phomsoupha 2011).

According to village off-grid promotion and support scheme, provincial energy supply companies install SHS (20-50 Wp) and rent out the systems to villagers. As condition of village off-grid promotion and support scheme, at least 50% of the households of a village need to sign up to be connected with solar electricity (Bambawale et al. 2011). Afterwards, provincial energy supply companies install the SHSs and handover services to village entrepreneurs (Village Electricity Managers-VEMs) (VOPS 2011). Village off-grid promotion and support office pays 2USD to provincial energy supply companies for signing up of each household, 1USD for installation, and 20–35% of end user's monthly payments as incentives and services fee (Bambawale et al. 2011). Also, the village head acts as village electricity manager, works with provincial energy supply companies for making decision about electrification on behalf of the villagers. Village electricity managers hire the systems from provincial energy supply companies, rent out to customers in contractual basis (5 or 10 years) and collect monthly electricity bill (Bambawale et al. 2011). When all the

[53] http://www.cap-redeo.com/upload/NL16.pdf

monthly installments are collected successfully, customers can own the system (VOPS 2011). Village electricity managers take 20–35% of the monthly payments of customers as a salary for services. Rest of the monthly payment goes to Village Off-grid Promotion and Support office to establish Rural Electrification Fund (REF) under the supervision of fund manager. This fund is used to provide incentives to provincial energy supply companies and buy spare-parts of SHSs (Bambwale et al. 2011; PREGA 2007). In addition, provincial department of energy and mine regulates provincial energy supply companies and inspect the quality of installation, operation, maintenance and take decision about further expansion of program. Village Electricity Advisory Committee (VEAC) monitors the performance off-grid electrification program at the village level (VOPS 2011). Figure 5.2 describes the RET implementation mechanism of GoL.

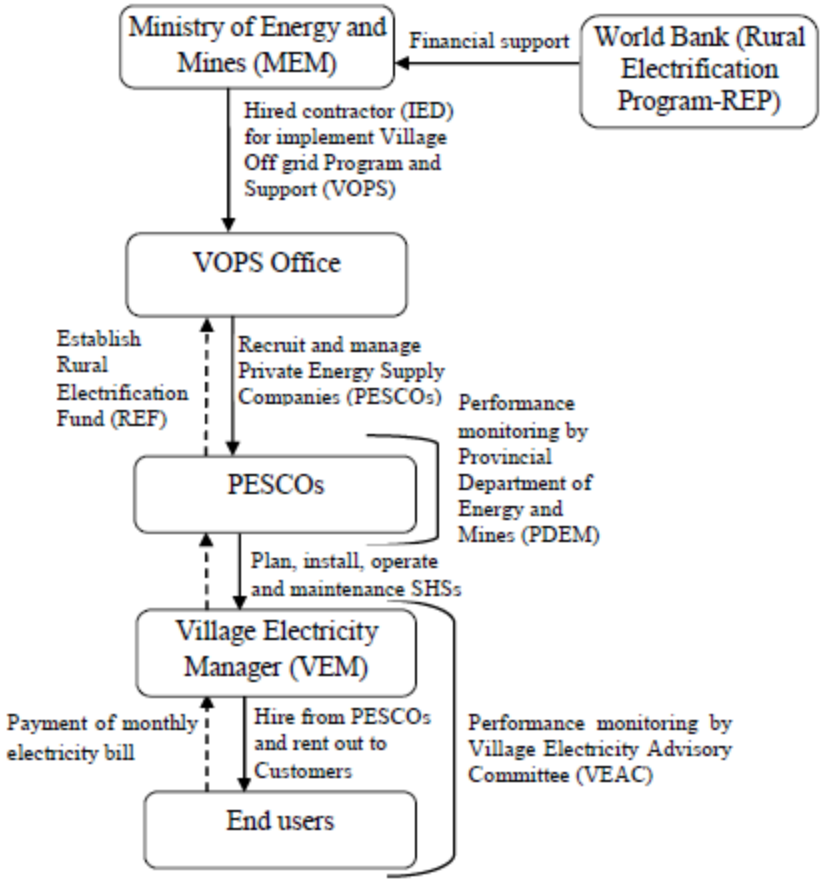

Figure 5.2: RETs implementation mechanism of MEM, Lao PDR

According to the RET implementation mechanism of village off-grid promotion and support scheme, Ministry of Energy and Mines follows the 'hire and purchase' business model for disseminating SHSs. The main advantage of the mechanism is that customers own the SHS after completing the installments of monthly electricity bills. It can be also said that GoL formulated a temporary arrangement for RETs dissemination by providing financial assistance for installing SHSs. Besides, this implementation mechanism only supports small scale provincial energy supply companies under government supervision rather than independent renewable energy based power generation by private sectors. Therefore, GoL is still lacking of an institution to support RETs implementation in off-grid areas.

III. Stakeholders in renewable energy sectors

Different stakeholders (individuals, groups, institutions etc.) are related to renewable energy sector of Lao PDR and contributing differently in renewable energy development. Stakeholders of an intervention can be identified by stakeholder analysis. The stakeholders of Laotian renewable energy sectors are analyzed by applying 'COWI check list of stakeholder analysis' COWI (2000). The checklist consists of five questions: 1) who depends on the intervention? 2) who are interested in the outcome of the intervention? 3) who will influence the intervention? 4) who will be affected by the intervention? and 5) who will work against the intervention?

By answering the first four questions; the stakeholders of the renewable energy sector of Lao are represented (table 5.3). However question 5, is not taken in to consideration because there is no lobby against renewable energy development.

Table 5.3: Stakeholders of renewable energy program of Lao PDR

Stakeholders	Focus area	Example of stake holders
Focal point	Policy formulation, strategic planning	Ministry of Energy and Mines (MEM)
Renewable energy research organizations	Research and Development	Technology Research Institute (TRI), The National University of Laos (NUOL), Laos Institute of Renewable Energy (LIRE)
Financial organizations	Financing renewable energy projects	World Bank, Asian Development Bank (ADB) Norwegian Agency for Development Cooperation (NORAD)
Industries	Not identified	
Implementing Organization (Private sectors and public sector)	Implementation of RET	Provincial Energy Supply Company, Sunlabob, NEDO
End users	Utilization of RET	Different RET users

Source: Author's own elaboration

Based on the outcomes of stakeholder analysis, Ministry of Energy and Mines is the key stake holders as they are providing policy and institutional support for renewable energy development. However, Role of private sector is not satisfactory except Sunlabob due to lack of policy and institutional support from government. Also, end users are well organize and headed by village energy manager (the chief of village). Again, some INGOs (International Non-Government Organizations) also evolve as implementers like NEDO (New Energy Development Organization), CIDA (Canadian International Development Agency), SIDA (Swiss international Development Agency) with their own mission of development. Again, participation of both public and private institution is a good sign of renewable energy research and development. But some stakeholders are yet to develop in Lao PDR for renewable energy promotion and development such as RET manufacturing industries and domestic financial institution. However, Bambawale et al. (2011) emphasizes on strong policy measures and incentives for emergence of domestic private and public institutions.

5.2.4. Findings from the analysis of business environment: Analysis of business environment for renewable energy uncovers some features:

5. SHS and Pico Hydro power are best practiced small scale RETs among off-grid people
6. All most all the people of Lao PDR fall under BoP market in comparison with BoP income benchmark (<3000USD). Also, this BoP market has some constraints, which include lack of customers' information such as information on energy expenditure pattern, low level of knowledge and skills on RETs, poor physical infrastructure and low rate of access to financial services (credit, savings, deposits and insurance).
7. Government of Lao has clear goal of renewable energy development. After all, regulatory environment for renewable energy development is not satisfactory because, still they don't have any active policy framework for renewable energy. Although, government has adapted temporary RET implementation framework, it is not supportive to large scale and independent private sectors.
8. In Lao PDR, government is the main stakeholder of renewable energy sectors by participating in planning, development and implementation of RETs. But the renewable energy based private sectors is small.
9. According to drafted National Renewable Energy Development Strategy (2010), government has good intention to promote private sectors. But at present condition, there is no notable support for private sectors due to absence of policy framework and institutional settings (figure 5.3).

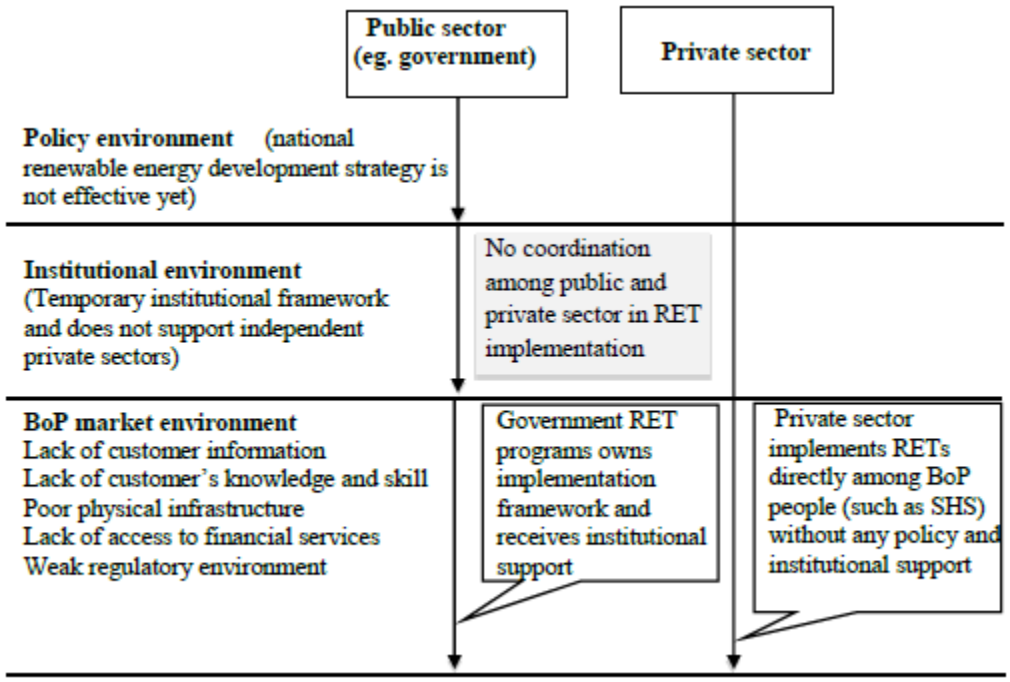

Figure 5.3: business environment for private sector in Lao PDR (Author's own elaboration)

It can be said that Government of Laos is on the way of developing the regulatory environment. Therefore, participation of private sectors is limited due to lack of financial, institutional and policy supports for RET business. Moreover, there is no coordination among stakeholders (public and private sectors) of renewable

energy due to absence coordinating agency. As result, participation of private sector in renewable energy business is very challenging due to identified BoP market constraints. Therefore, private sectors need to develop their market ecosystem of BoP business model in such way that can overcome the mentioned constraints by applying BoP business solution approaches.

5.3 Business Model of Sunlabob

Sunlabob is a private company in Lao PDR implementing small-scale decentralized RETs (green sprouts) (Smits 2011a; PREGA 2007). Sunlabob's activities are coordinated from its head office in Vientiane, the capital of Laos (Anon 2009). The head office has a team of 44 employees working on product design, engineering, business development, marketing, project management, energy audit; RET system construction, installation and distribution (Anon 2009). Besides, Sunlabob has an electronics assembly and testing workshop in head office (Schroeter 2009). From head office, the renewable energy programs of Sunlabob are operated by distributed network of Sunlabob's authorized franchises to achieve nationwide coverage (Henshel et al. 2010). Because, many in the head office can't communicate in local language and also, rural infrastructures are not so well that the team of head office can easily move to remote rural areas (Anon, 2009). The franchisees are thoroughly trained by Sunlabob on system operation, system maintenance and local level marketing. Afterwards, they represent Sunlabob in provincial level by carrying out installation, maintenance, local level business development and collection of bills; and ensuring the availability of spare parts (Henshel et al. 2010). There are over 12 Sunlabob franchises all over Lao PDR (Anon 2009).

Energy solutions of Sunlabob offer electricity facilities for off-grid people through bunch of RETs. According to Sunlabob, these RETs are reliable and affordable for Laotian because they are localized solution and competitive in prices. The offered RET solutions for electricity are presented in the table 5.4:

Table 5.4: Sunlabob's energy solutions

Type of business	energy solution	component
Renewable energy services	Solar energy	SHS
	Village Hybrid Grid	Solar PV + wind turbine+ micro hydro+ biofuel based diesel generator (only as back up)
	Solar Lantern System	Rechargeable lantern+ solar charging station
Hardware distribution	Solar powered irrigation	Solar PV+ water pump
	Water purification	Solar PV+ water pump+ water purifier
	E-cycle	Bi-cycle + rechargeable Li ion battery
	Renewable energy equipment	Solar panel, charge controller, LED system, DC monitoring devices, inverter
Energy auditing	Commercial energy auditing	Identification of present energy use+ explore the potation energy savings+ suggestions for energy efficient products

Source: Sunlabob 2011

In Laos, Sunlabob has reached about 1000 villages and 30000 households with their RET solutions for off-grid electrification (Anon 2009). Moreover, their business is not only restricted to Lao but also entered into

Uganda. In Uganda, they are implementing SHS on rental basis by establishing a franchise over there (Sunlabob 2011b). Due to expansion of business, Sunlabob need investment from private sector; this is not easy from banking sector of Laos. Therefore, they have register Sunlabob International in Singapore to channel the fund to their projects areas (Anon 2009).

According to the company information, Sunlabob is offering multiple renewable energy services and products to off-grid people. Therefore, PREGA (2007) define Sunlabob as only significant private company in renewable energy sector of Lao PDR. Specially, they install SHSs in off-grid areas of Lao PDR adapting innovation business model. Thus, SHS program of Sunlabob justifies itself suitable to be considered as a case.

In this section**,** Sunlabob's business model will be analyzed in broader perspective to explore-how the business model alleviates energy poverty. According to the section 5.2.4, Lao renewable energy market represents BoP market and therefore, BoP business model could be a solution to alleviate energy poverty for BoP. Therefore, Sunlabob business model will be examined to explore business model development procedure, co-creation and native capability of the business model, market ecosystem, system of innovation for RET implementations and impacts on beneficiaries, sustainability.

Firstly, the reasons behind Sunlabob's establishment will be discussed in 'Genesis of Sunlabob' and process of establishment will be compared with 'BoP protocol' to find out whether they followed protocol or not. Secondly, Sunlabob's business model will be analyzed to examine co-creation and native capability of the business model. Thirdly, success of Sunlabob's business model for implementing SHSs will be checked in the lens of system of innovation. Fourthly, market ecosystem of the business model will be analyzed to examine-how successfully Sunlabob overcome the identified market constraints. Fifthly, impacts of Sunlabob SHS business on customers, franchisees, community will be assessed by BoP impact assessment framework. Finally, triple bottom line assessment (social, economy and environment) will evaluate the sustainability of the business.

5.3.1 Genesis of Sunlabob: Andy Schroeter, a German national and electrical engineer by profession came to Lao PDR as employee of GIZ (German Society for International Cooperation) in 1995 and resided in remote rural place of northern part of the country, close to China border up to end of his assigned job in 2000 (Anon 2009; Schroeter 2011). The area had lowest access of electricity of Laos while at the same time; only 16% of Laotian had electricity access on average. Even those areas were severely lack of water, energy and medical services (Schroeter 2009). Such distress situation of people inspired entrepreneur minded Andy Schroeter in many ways (Schroeter 2011). Firstly, as an activist of German's anti-nuclear movement in late 70's, he has a passion on renewable energy. Secondly, he believes that government initiatives and foreign aid programs are not enough to provide energy services sustainably, requires intelligent business model. Briefly talking about business model, Schroeter felt about the model that integrates the partnership among public and private sectors where private sector would come with operational business model of energy service and

public would be implementer for the end users. Thirdly, decentralized RETs can play role to electrify sparsely populated Lao population. With all these logics, Schroeter came up with an idea of establish a renewable energy service company in 2000. He along with a Laotian partner set up Sunlabob Renewable Energy Limited as registered Lao for profit-company in 2000 with an initial investment of 500,000 USD (Anon 2009). Since Sunlabob's inception, it holds the aim of providing affordable and reliable renewable energy solutions to alleviate energy poverty. They have long-term mission of becoming regional leader of renewable based energy solutions provider and hardware seller (Sunlabob 2011a).

It can be said that Sunlabob operates business to alleviate energy poverty of off-grid people through commercial exploitation of renewable energy resources, which fit the of BoP approach. More explicitly, they innovate operational business model for reliable and affordable energy solutions which provide improved energy services (such as solar electricity) for rural Laotian and at the same time make profit for Sunlabob. According to the genesis, it was clear that Sunlabob was not established as per the guidelines of BoP protocol. They jumped directly to enterprise creation rather that following the earlier steps of protocol such as co-inventing leadership team, formation and training of field immersion team, site selection, partner identification, building of market ecosystem. Because, Andy Schroeter founded Sunlabob based on his passion on renewable energy and years of on the ground working experience on Laos. Therefore, he utilized own knowledge's rather than testing the business idea in formal ways stated in BoP protocol. Therefore, it is arguable that this kind of venture may not reflect the co-creation of business model, native capability and embedded innovation in a form that BoP protocol expects. But based on practical consequence, it was not possible to comply with protocol as the Sunlabob was founded before the evolution of BoP concept. Therefore, it can be concluded that Sunlabob renewable energy business supports the BoP (Green Leap) approach but not necessarily the protocol.

5.3.2 Rental SHS business model of Sunlabob

The SHS business model of Sunlabob's consists of several steps: identification of the project area, marketing of rental SHS, installation of SHS, selection of village energy committee, payment of monthly electricity bill and options of public-private partnership. How Sunlabob business model runs in practice is described below.

Identification of project area: Sunlabob identifies project areas for rental SHS business with the assistance of Ministry of Energy and Mine. Areas, about 50 km away from existing grid and would not have any possibility to connect with grid in near future (10 years) are potential for projects (Anon 2009; Theuambounmy no year). Further, the Sunlabob team has the ability to study the potential areas for business development due to presence of Laotian both in top management and staff level (Anon 2009).

Marketing of SHS: After selecting the potential areas for electrification, Sunlabob team begins marketing by contacting the villagers. They spend time in villages for explaining how SHS works, what would be the monthly payments, how Village Energy Committee (VEC) will be formed. They also install a SHS in the village to demonstrate how it practically works due to lack of knowledge of villagers about SHSs. Therefore,

villagers can see practically how SHS works and able to compare solar light with kerosene lantern and candle (Schroeter 2007a). Therefore, demonstration of SHS could be argued as a strong marketing technique of Sunlabob's business model and thereby helpful to convince the potential customers.

Installation of SHS: After gaining support from the villagers to install the SHSs, they apply for approval from the districts level administration to off-grid electrification project (Schroeter, 2007a). After the acceptance from the government, villagers select village energy committee and village technician. Village energy committee signs contact with Sunlabob on behalf of end users. Then, Sunlabob authorized franchisees install the SHSs. The solar panel is mounted on a standing pole rather than fixing on the household rooftop. It allows the panel to move towards the sun direction and therefore, generate more power. The battery and charge controller are locked in box and village technicians keep the keys. These measures can be explained as the security of SHSs. Sunlabob can provide SHS according to the demands of the customers. But 20Wp panel with 33Ah battery is more popular among users as it matches with consumer's affordability level. This type of SHS can run 2 CFLs of 2-7W for 3-4 hours at night. However, some households use bigger system to run television, cassette player, and other electronic equipments (Schroeter 2007a).

Formation of Village Energy Committee (VEC): In rental SHS business model, Members of Village Energy Committees (VECs) receive formal training form franchises and manage the energy requirements for the end users such as which system they need, collection of the monthly bills from the users, manage the defaulters, and monitor the work of village technician. Further, they also handle the decision if anyone wants to take bigger system or quit from renting system. On the other hand, Sunlabob franchises also train village technicians on day to day operation and maintenance of SHSs. Later, they do maintenance of SHSs, try to fix problems of system and lamps complained by users, collect the old battery and send to Sunlabob for recycling. If the village technicians are not able to solve the problems, then it is handled by nearest franchise (Schroeter 2007a). In conclusion, it can be said that trainings of Sunlabob improves develop knowledge and skill of local people engaged as member of village energy committee and village technicians and franchisees.

Payment of monthly electricity bill: Users of rented SHS pays monthly bill on kWh basis to the village energy committee. Moreover, they need not pay the bill, if system fails. Thus, it is a real incentive for the users in a sense of 'payment on actual use'. Usually, women pay the monthly bill to village energy committees as they are responsible for household's finances, which also include the lighting cost. As Sunlabob runs the business in fully commercial basis, therefore the electricity bill covers all the cost: capital cost, installation cost, maintenance cost, service cost, salary of the village energy committee and village technicians. As for example, the monthly electricity bills of 20Wp and 100Wp cost 35000kip[54] (≈4.5 USD) and 160000kip (≈20 USD) respectively while, rural households spend about 36000-60000 kip (≈4.50-7.50

[54] Kip is the currency of Lao PDR. 8034 kip= 1USD (21.04.2011)

USD) monthly for kerosene (Schroeter 2007a). Moreover, Schroeter (2007) argued that households could rent small SHSs instead of kerosene lantern spending the same amount that they do spend for kerosene.

Option of Public-Private-Partnership: Sunlabob allows PPP (Public-Private-Partnership) in their business model. Because, such partnership allows public fund in private sector and mutually leverage each other ultimately. Literally PPP defines-'…..*a range of possible relationships among public and private entities in the context of infrastructure and other services (power generation and distribution; pipelines, hospitals; water; sanitation etc)'* (ADB 2008:2). PPP creates a chance of attracting private investment, uses resources efficiently and effectively; and reforms sectors through re-allocation of roles, provide incentives and improve accountability (ADB 2008). Therefore, PPP could help to implement off-grid electrification programs by encouraging private sectors, ensuring the utilization of renewable energy and reforming the power sector toward sustainable energy development. Following PPP concepts, Sunlabob's rental business model welcomes public fund (grant, loans) to implement their business model of off-grid electrification (Sunlabob 2011a). The sources of fund could be government, donor agencies, international NGOs (Sunlabob, 2011b). Sunlabob suggests public fund for fixed assets such as SHSs for rental program; (Sunlabob 2011; Sunlabob 2006). Schroeter (2011) commented on implication of PPP in renewable energy business by saying- 'Commercial business is not viable at all when you focus at BoP. We need here the huge involvement of public side otherwise it is not viable'.

Since establishment, Sunlabob is concentrated on rental based business model and therefore can be termed as rental company (Sunlabob, 2011a). But, Sunlabob realizes that rental projects are not commercially viable as it requires large investment for long term (Anon 2009). Therefore, it can be assumed that it takes long time to return the investment with profit. To overcome these drawbacks, they involve in direct sale and third party project implementation of renewable energy projects. Sunlabob also supports such businesses for achieving company's missions. As a part of direct sale, Sunlabob participated procurement process of SHS (panels, wires, charge controllers, battery, switches, inverters etc.) for World Bank's Rural Electrification Program-1 (Bambawale et al. 2011). In addition, they also sell rechargeable lantern and charging station to USAID-Afghanistan (Sunlabob 2011b). As third party implementer, Sunlabob installs RETs for supplying electricity when they are paid by donor agencies, for the equipment and installation cost. Later, Sunlabob may also sign management contract with community for operation and maintenance by charging a fixed amount (Sunlabob 2011a). It is more affordable to customers than Sunlabob rental SHS; because customer need not pay the cost of system and installation cost. The figure 5.4 represents the Sunlabob business model.

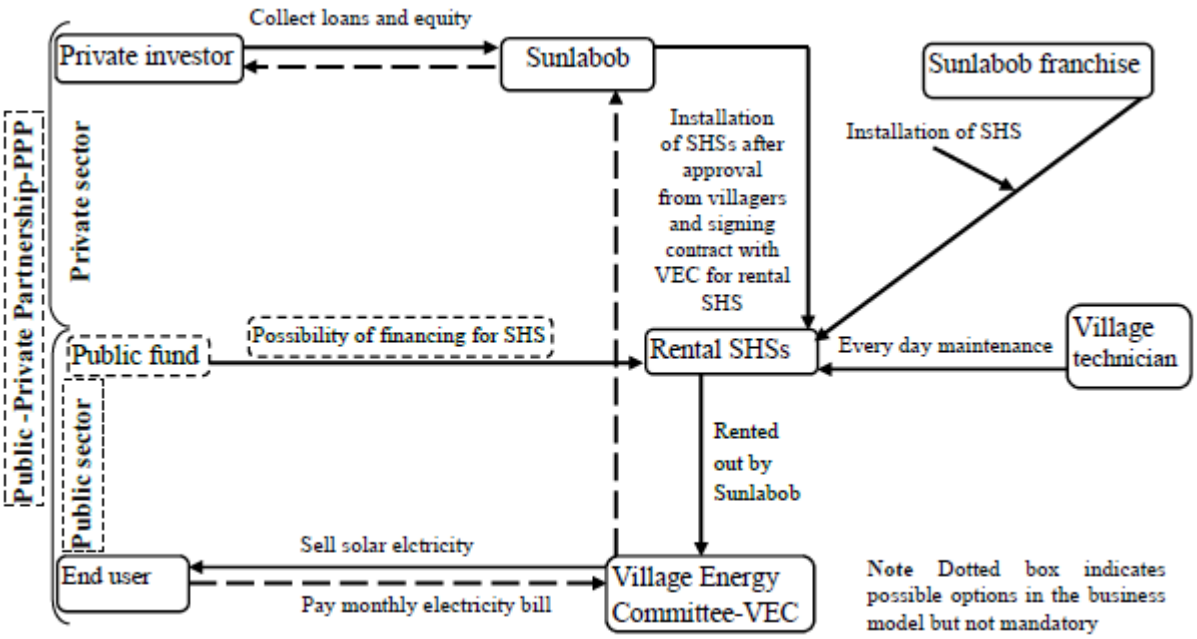

Figure 5.4: Sunlabob rental SHS business model (Authors own elaboration)

5.3.3 Findings from the business model: According to World Bank (2008), Sunlabob rental SHS business can be described as 'fee for service' model. In addition, it can be argued that paying monthly bill is affordable for villagers than buying SHS with a high upfront cost. Reversely, continuous spending for 'fee for service' would not be profitable, as customers do not can own SHSs after a period of time similar 'dealer based business model'

Besides, Sunlabob's business model engages local people as franchisee, village technicians and members of village energy committee. Even, the villagers have roles to approve of the off-grid electrification project, select of village energy committee and nominate village technician, which can be described as a process of co-creation in the business model where community's aspirations get preferences. As well, ability of Sunlabob's business model to develop trust, relationship and understanding; proofs it as embedded innovation. Moreover, opportunity to integrate of public private partnership in Sunlabob's model could stimulate profitable business for private sectors and help to attain social objectives of public stakeholders (INGOs, donor agencies, government).

5.3.4 Success of Sunlabob's rental SHS program: Sunlabob has installed more than 5000 SHSs (500 system/ year) adapting 'fee for service' business model (Schroeter 2007a; Sunlabob 2011a) in off-grid areas of Lao PDR. Therefore, they can claim success of their business model. Therefore, Based on Mondal et al. (2010), how the business model works as system of innovation could be taken into consideration to investigate the success of SHS implementation. Sunlabob's business model is analyzed below based on the building blocks (technology, related knowledge and skills, networks of actors and institution) of innovation system (see figure 5.5).

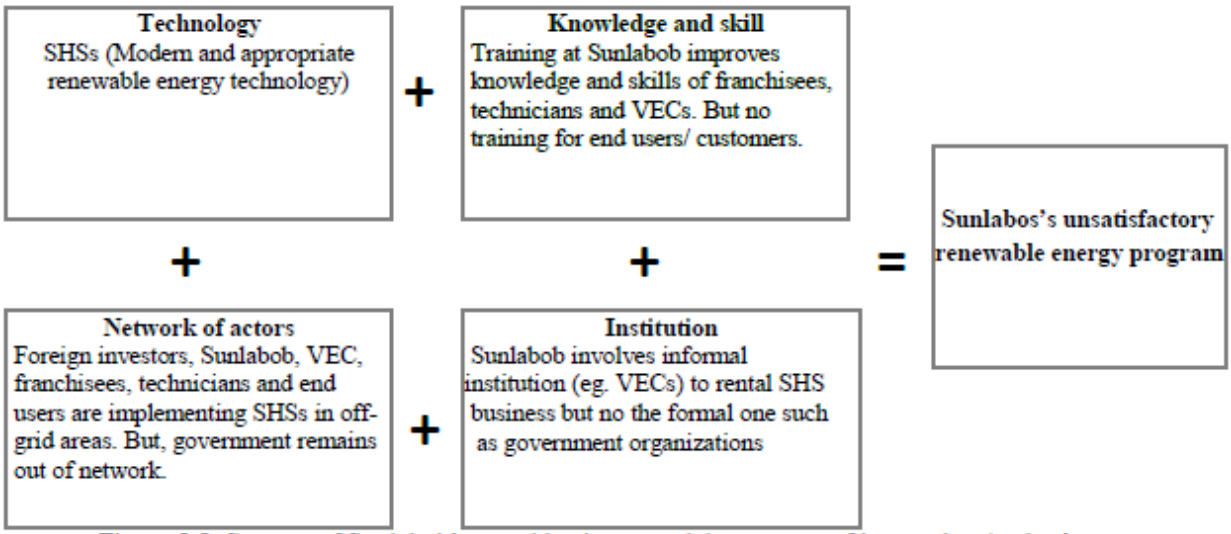

Figure 5.5: Success of Sunlabob's rental business model as system of innovation (author's own elaboration)

Sunlabob install and operate SHS to supply solar electricity for off-grid Laotian. According to Biswas et al. (2001), it could be defined as appropriate technology as it saves resources by utilize solar energy, increase productivity by extending working hours and gives comfort by providing solar electricity instead of kerosene light. Through business model, Sunlabob improves knowledge base and develops new the skill of the franchisees, members of village energy committee and village technicians by training. But, they don't have technical center such as Grameen Technology Center (GTC) of GS. As a result, end users end don't have access to improve knowledge about SHS. However, in fee for service business model of Sunlabob customers do not own the system and not responsible for taking care of the SHS regularly; therefore, it not mandatory to train the customers.

Sunlabob develops networks of actors with foreign investors, end users, village technicians, VECs, and franchisees. Sunlabob is also a part of the same network of actors as energy service provider. But, government organization is not a part for their network of actors, though collaboration with government is considered one of the solution approaches of BoP business (Gradl et al. 2008). Because, World Bank (2008) considered government as an element of success for sustainable off-grid electrification project providing policy and institutional supports. But, reality is that, Lao government does not provide any financial and policy supports for private sectors. Therefore, Sunlabob has developed their networks of actors without including government.

However, weak networking with government could cause failure to privately operated for-profit renewable energy. For an example, Sunlabob became uncompetive in rental SHS business due to highly subsidized SHSs implementation program of World Bank 'Rural Electrification Program-I and II'

In 'Rural Electrification Program-I' provided an incentive to customer to own SHS after paying the installments (5 and 10 year installment) successfully. Compare with Rural Electrification Program -I, Sunlabob's rental business turned into uncompetitive due to high monthly fee for customers. As for an

example, for 20 Wp SHS end users has to pay 13000 kip (≈1.6USD) (10 years installment) and 26000 kip (≈3.5 USD) (5 years installment) per month under Rural Electrification Program -I while users pay 35000 kip (4.5USD) to Sunlabob for the same system (Bambawale et al. 2011;Schroeter, 2007a). From the price comparison it clear that users pay less monthly bill when they rent SHSs from Rural Electrification Program-I and thereby more affordable to end-users. Even in Sunlabob's business model, users can-not own the system. Thus, Rural Electrification Program-I and II has made Sunlabob's business uncompetitive. Smits (2011a) also confirms the reason of Sunlabob's failure-'……different SHS models out there (in Lao PDR). Sunlabob was one of them (implementing RETs), but the World Bank is putting in massive numbers of subsidized SHS. ……no body would be able to compete with their (World bank's Rural Electrification Project) model, because nobody could afford such heavy subsidies[55]'. Thus, it can be proved that subsidized SHS program of World Bank halted the success of Sunlabob's rental program. Because, neither Sunlabob works under GoL, RET implementation mechanism nor collaborates with governments for own business.

Finally, in case of institutions, Sunlabob establishes VEC (Village Energy Committee) as local institutions. It can be argued that they do maintain local culture, customs in business and ensure community engagement in SHS rental business.

As system of innovation, SHS implementation program of Sunlabob addresses technology, related knowledge and skills, network of actors and institutions for SHS implementation. But finally, Sunlabob is defeated to World Banks projects of SHS due to unfair competition. Therefore, Sunlabob's business model is not successful system of innovation for RET implementation even after addressing technology, knowledge and skills, network of actors and institution properly.

5.4 Evaluation of Sunlabob's Rental SHS Business Model

In this subsection, Sunlabob's SHS business model will be evaluated based on market ecosystem, the impacts of Sunlabob's business on the ground and sustainability of the business. Firstly, market ecosystem of SHS business model will be analyzed with an intention to investigate how-successfully Sunlabob overcomes the identified market ecosystem. Secondly, BoP impact assessment framework will be used to find out the changes in economics, capabilities and relationship of customers and communities due to utilization of SHSs. Finally, triple bottom line (economy, society and environment) of Sunlabob's SHS business will be assessed to identify the sustainability.

5.4.1 Market ecosystem of Sunlabob's rental SHS business model: Sunlabob has developed the market ecosystem of rental SHS business for off grid Laotian, where market conditions (constraints) interact with market actors. According to the analysis of market information, renewable energy market of Lao PDR has market constraints such as lack of information, low level of customer's knowledge and skills, early stage of regulatory environment and lack of physical infrastructures. Besides, actors of the renewable energy

[55] the comment was sent in email by Matijs Smits

market include GoL, private sector (eg. Sunlabob) and end- users. Therefore, market ecosystem of Sunlabob business model will be examined to find out- 'how Sunlabob business model solves different identified market constraints applying BoP business solution approaches?'

Sunlabob overcomes the market constraint of –'lack of customer information' through adapting business model that allows the flow of customer's information from project areas to head office of Sunlabob in Vientiane. They employ village technicians and village energy committee at local level. These people are the part of community and possess bunch of information on preferences and choices of community people. Also, the Laotian staffs of head office and distributed network of franchise contribute to collect market news and views for renewable energy business.

Sunlabob invests resources (eg. financial and technical) to improve the knowledge and skill of franchisees, village technicians, member of village energy committee to create enabling environment for SHS business. Sunlabob trains village entrepreneurs and authorizes the establishment of franchise. Then the franchisees train the village energy committee and village technicians to make them compatible for rental business.

According to the result of market information analysis (section 5.2.4); supportive regulatory environment for renewable energy development is in the stage of development and does not provide any incentives to private sector till now in Lao PDR. However, Sunlabob takes approval of local administration for implementing rental SHS projects and take assistance of Ministry of Energy and Mines (MEM) to identify potential areas of off-grid electrification; which could be kind of collaboration with government. But such collaboration with government doesn't provide any notable support for rental SHS business such as grants, subsidies, tax exemption and import duty exemption.

Business model of Sunlabob does not apply any solution approach for overcoming the constraints of 'lack of access to financial resources'. Actually, they try to maintain the affordability of customers by introducing monthly fee for using SHS. But it can-not be an effective solution instead of accessing financial services (savings, microcredit, insurance etc.).

Finally, physical infrastructure is a market constraint for the business of Sunlabob as they are implementing SHSs in remote and rural areas. They have solved the problem by establishing a network of franchises at provincial level, train the Village Energy Committees and village technicians. Therefore, collaboration with communities and investment of resources are the solutions applied to overcome the constraint of 'poor physical infrastructure'. At the end, the market ecosystem of Sunlabob's rental SHS business is presented in the figure 5.6.

		Solution approaches				
		Leverage own capabilities		Collaboration with other stakeholders		
		Rental business model adaptation	Investment	Off-grid communities	Organizations	Government
Market constraints	Market information	√		√		
	Knowledge and skill	√	√	√		
	Regulatory environment					√
	Access to financial resources	√				
	Physical infrastructures		√	√		

Figure 5.6: Market ecosystem of Sunlabob (author's own elaboration)

Market ecosystem of Sunlabob's SHS business model cannot overcome all identified market constraints. According to the market ecosystem analysis, Sunlabob overcomes some of the constraints successfully such as lack of market information, poor physical infrastructure and lack knowledge and skills. But the business model of Sunlabob can-not adapt effective solution approaches to solve the market constraints of 'weak regulatory environment' and 'lack access to financial resources'.

5.4.2 BoP impact assessment of Sunlabob's rental SHS business: Sunlabob's business model is implementing SHS on rental basis in off-grid Laotian people. In addition, analysis of market information reveals that Sunlabob is operating business in BoP market. That's why, assessment of this business ventures is necessary to measure impacts (positive and negatives) and changes done by their activities. According to London (2009), BoP impact assessment framework evaluates-how BoP business affects the well-being (economic changes, capabilities changes and relationship changes) of relative stakeholders (buyer, sellers and communities). In this section, impact of Sunlabob's business will be assessed to find out the positive and negative changes on it's end users, local entrepreneurs (village technicians and franchisee) and communities.

Changes in economics: Changes in the economic perspective cover gains or losses in income, assets, liabilities etc. BoP impact assessment of Sunlabob's business has realized the following changes in economics among customers, communities and village entrepreneurs (village technicians and village energy committee).

1. Sunlabob's SHSs program brings the opportunities to the Laotian people to compare the lighting cost of kerosene with SHSs. Sunlabob (2011a) claims that SHSs provide electricity in competitive price (than kerosene lantern or diesel generator) to customers and even cheaper in the long run (Sunlabob 2011a). But, Rural Electrification Program (REP) of World Bank provides solar electricity in more affordable price than Sunlabob with an opportunity to be an owner after completing contract period. Therefore, price of Sunlabob's solar electricity economically less affordable to community people and affecting the economy of the customers negatively.

2. Village entrepreneurs (franchisees and village technicians) get job opportunities under the business model of Sunlabob. Besides, member of Village Energy Committee can generate extra income for managerial services. Further Sunlabob (2011a) claims that application SHS in business purpose such grocery shops can generate extra income. Because, they can use TV or CD player for in their shop, which retain customer in shop for long time and they buy more stuff such as snacks, drinks and beers. Thus, they can improve the economic condition and livelihood.
3. Applications of rented SHSs increase the productive hours for the households such as making handicraft during nighttime and thus improve the household income and wealth.

Changes in capabilities: In BoP impact assessment, changes in capabilities investigate influence on health, skills, confidence of individuals and communities needed to help themselves. Following changes in capabilities are realized among customers, communities and village entrepreneurs (village technicians and village energy committee).

1. Sunlabob rental SHS business improves the knowledge and skill of the local people. Sunlabob trains franchisees, village technicians and village energy committees and result is positive changes in capabilities.
2. Households application of SHSs extend the study hours of children. Schroeter (2007a) claimed that children from electrified households do better in exam than those who don't have the facility (Schroeter 2007a).
3. Application of SHSs develop the capability to use local resources such as solar radiation
4. SHSs provide the opportunities of enjoying television and using mobile phone (allow to recharge mobile phone). Watching educational programs in TV and access to communication using mobile build awareness among community people.
5. Besides, use of SHS brings change in the life of women. They can avoid kerosene lamp which cause fumes (indoor air pollution) and fire hazards. Therefore, it can be argued that it can improve health of family members and secure women in every-day-life.

Changes in relationship: In BoP impact assessment frame work, changes in relationship assess whether BoP business provides access to networks and partnership; and reduce social exclusion; and geographic isolation or not. Following changes in relationship are realized among customers, communities and village entrepreneurs (village technicians and village energy committee).

1. It can be said that Sunlabob's rental SHS brings new relationship and develops trusted relationship with customers. Actually, it develops business relationship among Sunlabob, end users, franchises and Village Energy Committees.
2. Sunlabob's business model helps to forms new village institution called village energy committees based on the culture, disciplines and tradition of local people (Sunlabob, 2011).

3. Application of SHS could increases the social status of users than those using kerosene lamps. Because, SHS improves the living standard of people.
4. Application of SHS saves environment by reducing the emission of CO_2. According to Henshel et al. (2010), each kerosene lamp emits 100kg of CO_2/year and therefore, replacement of kerosene lamps with SHSs protects nature. Thus, more responsible behavior to environment could develop new positive relationship with environment. The overall changes of Sunlabob's rental business model are presented in table 5.5.

Table 5.5: Impact assessment of Sunlabob's BoP business

Village entrepreneurs	Customers	Communities
Realized changes in economics		
1.Employment opportunities 2.Income generation	1.Solar electricity in less affordable price. 2.Increase productivity	1.Economic development
Realized changes in capabilities		
1.Technical knowledge and skill development	1.Educational development 2.Entertainment opportunities 3.Awareness building 4.Access to information 5.Use of local resources	1.Social development 2.Improvement of living standard
Realized changes in relationship		
1.Development of trusted business network (Sunlabob-franchise-village technicians)	1.Increase social status 2.Social networking among SHSs users 3.Trusted relationship with VEC, 4.Sunlabob and village entrepreneurs	1.Development of local institution (eg.Village Energy Committee) 2.Relationship with environment

Source: Author's own elaboration

Sunlabob's rental SHS business model has brought changes to end users, village entrepreneurs and VECs. According to the result of assessment, all the changes are positive to the stakeholders except the monthly payment for SHSs. Price of the electricity is most important factor fee for service business model, though the electricity bill of Sunlabob is not the most affordable one. Therefore, due to realized changes, Sunlalob's rental SHS program can-not be sustainable until the price of the solar electricity would be competitive and affordable to the end users.

5.4.3 Sustainability of Sunlabob's rental SHS business model: Motivation of Sunlabob's business venture to alleviate poverty profitably is not enough to attain sustainability. Because, BoP business (such as Sunlabob's) SHS business, mainly looks the economic aspect but impacts of business chain on the society (community) and environment are equally important and need to be evaluated (Hart 2010). So, sustainability assessment of business venture is crucial to identify and prove that problems solved by the business intervention are more influential than problems that would be created (Hart 2010). In section 5.4.2, economic, capabilities and relationship changes are identified by BoP impact assessment framework. Therefore, it gives idea on economic and social impacts. But environmental impacts of Sunlabob rental SHS

business model still remain uncovered. So, triple bottom line (economy, society and environment) of Sunlabob's business need to be assessed to investigate the sustainability.

Rental SHSs business of Sunlabob cannot provide cheaper solar electricity than World Bank's SHS programs. Because, SHSs that World Bank program offer is highly subsidized (grants form Global Environmental Facility and import duty free duty). So, Sunlabob's rental SHSs business is not economically sustainable. After all, it can bring some positive economic impacts (if SHS is used) such as employment creation for village entrepreneurs and income generation for VEC and end users. It could also increase the monthly energy expenditure of end users if they rent a SHS which cost more than they used to spend for kerosene. Further, application of SHS brings the opportunities of using other electronics such as TV and mobile. So, household application of SHSs could increase the consumerism; which could not be acceptable without increasing the income of the end users. Besides, local shops may lose the customers of kerosene and could impact negatively in their business.

Social impacts of Sunlabob's SHSs program include: improvement in children education, opportunities of entertainment, access to information (by using mobile), skills and knowledge, development, and building of new relation (end users, village entrepreneurs and Sunlabob), upgrade of end user's social status and establishment of new social institution (eg. village energy committee). However, it could cause some negative social incidents. As for example, defaulter of the electricity bill could face disciplinary actions; which could be a matter of social harassment. Also, mental conflict could be expected between SHS and kerosene lamp users due to change in the living standard.

The most important environmental benefit, that Sunlabob's business replaces kerosene use with SHS, which runs by locally available renewable energy (solar radiation). Thus SHSs reduce CO_2 and saves environment. Besides, Sunlabob collects battery for recycle. However, Sunlabob uses CFL for lighting in SHSs, which contains mercury. It is notable that mercury is heavy metal and harmful for human neural system (Matson 2008). Old PV panels also could create the electronic waste problems. If these problems are not addressed by Sunlabob, they could be potential threats in future for environment. Figure 5.7 represent the sustainability of Sunlabob rental SHS business model.

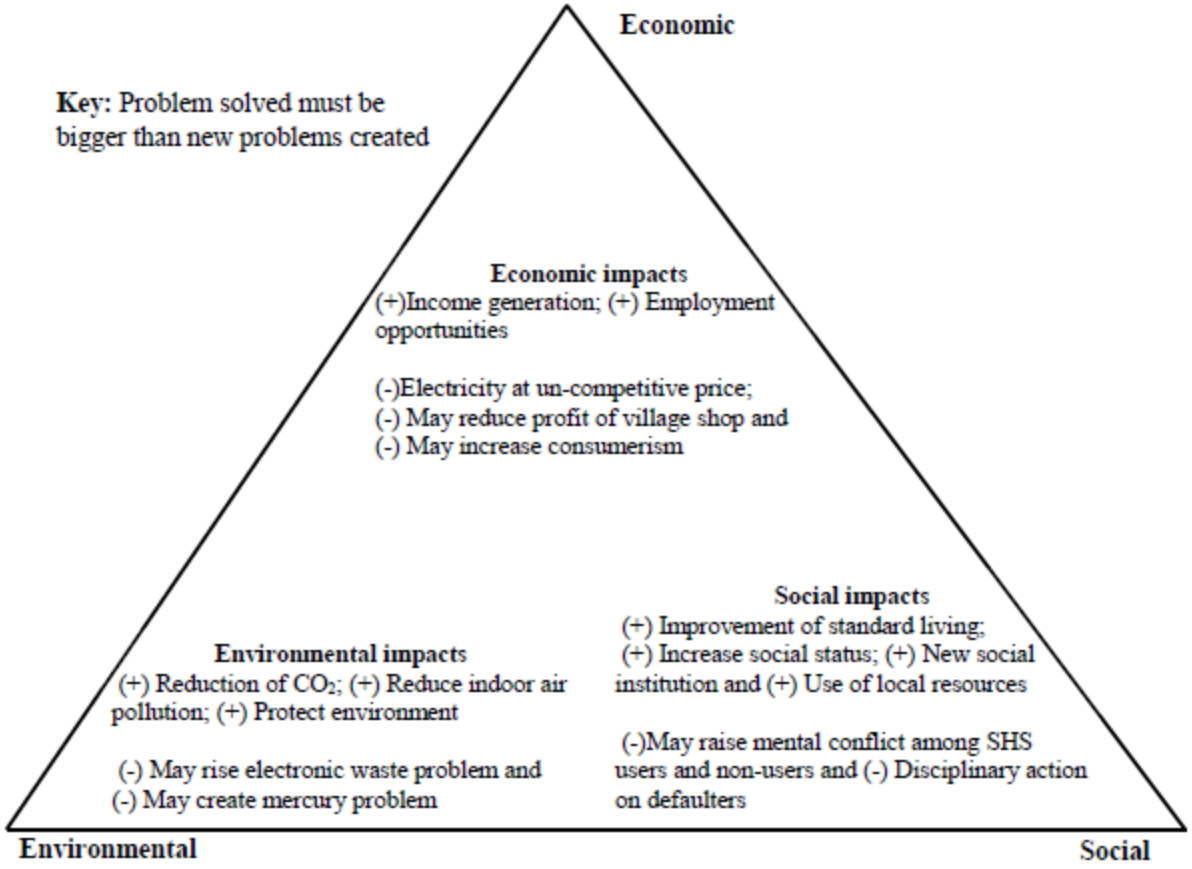

Figure 5.7: Sustainability assessment of Sunlabob rental SHS business model (author's own elaboration)

After assessing the sustainability impact of Sunlabob's business, it can be said that positive social and environmental impacts are significant than their negative impacts. But, some negative impacts such as electronic waste and mercury pollution could be potential threat for future sustainability of Sunlabob. In case of economic sustainability, uncompetitive price of solar electricity has more significant negative impact on business than all positive economic impacts identified Therefore; Sunlabob's BoP business model of SHS can-not alleviate energy poverty sustainably.

5.5 Chapter Findings

According the analysis of market information, renewable energy market of Lao PDR represents BoP market; which consists some market constraints as such lack of customer information; lack of customer's knowledge and skills; lack of access to financial resources; weak regulatory environment and poor physical infrastructure. In such a market, Sunlabob has been operating their rental based SHS business for alleviating energy poverty. Adapting 'fee for service' business model, they are serving solar electricity to off-grid people in market oriented approach, which justifies the BoP concept; though, they did not follow BoP protocol during the formation of the business model. Investigation of the business model reveals that Sunlabob ensures the co-creation and native capability of the business model by engaging local communities as franchisees, member of village energy committees. But, Sunlabob fails to develop a suitable market ecosystem for their SHS business model that can solve all the identified market constraints. Also, the rental

business model for implementing SHS is unsuccessful to be a system of innovation; because of highly, subsidized World Bank project. Further, SHS business of Sunlabob brings positive and negative changes in economy, capabilities and relationship. Among the realized changes, the economies of the customers are affected negatively as because monthly electricity bill is not affordable in compare with World Bank's SHS under rural electrification program. Finally, sustainability assessment has explored that the SHS business is not sustainable because, total positive social, economic and environmental impacts created by the Sunlabob are less significant than the negative impacts. Specially, the business model of Sunlabob is not economically sustainable for alleviating energy poverty at BoP due uncompetitive monthly solar electricity bill.

At the end, it can be said that rental SHS business owns the characteristics of fortune creating 2nd generation BoP business model by ensuring the co-creation and native capability of business model. But the BoP business model of Sunlabob turns into unsatisfactory one due to weak market ecosystem and imbalance completion between Sunlabob 'fee-for-service business model' and World Bank's hire and purchase business model; where World Bank SHS program receive grants from Global Environmental Facility (GEF) and import duty exemption from Lao government.

6. Learnings from the Business Models

6.1 Introduction

This chapter will present some generalized learnings based on the studied business model of GS and Sunlabob (Chapter 4 and 5). Firstly, the role of local organization; government; and grants and subsidies to develop successful BoP business model will be discussed. Secondly, transition of renewable energy market of Bangladesh and Lao PDR will be investigated so that private sectors can find out their future role in changing market. Finally, limitation of studied business models will analyzed with an intention to find out the solutions for sustainable energy development.

6.2 Learning from Business Models

6.2.1 Can local organizations alleviate energy poverty at BoP?

Analysis of GS's business model reveals that local organizations can alleviate energy poverty successfully by developing an effective market ecosystem. In GS's business model, market constraints are resolved by leveraging own business model; and collaborating with government and local communities. On the other hand local organization can be unsuccessful in BoP business such as the case of Sunlabob's rental SHS business model. Sunlabob became unsuccessful due to short fall in market ecosystem development and failure to provide solar electricity in lowest price comparing of World Bank's Rural Electrification Program. Though, Hart (2010) supports the low cost production as a strategy of serving BoP. But Sunlabob business model practically fails against high subsidy of World Bank; which not only hamper the business of Sunlabob also distorts the market. It is necessary to mention that, as a BoP business model, Sunlabob's fee for service model is operable to alleviate energy poverty in subsidy free market environment.

Moreover, it can be argued that local organization such as GS is successful due to their bottom up implementation approach and ability of the business model to operate in BoP market. On the other hand, multi-national companies (MNCs) prefer to do business in top-down approach with a centralized business mindset, high economy of scale and perfect market condition on top of economic pyramid (Hart 2010). Therefore, multi-national companies could remain alien if they serve the BoP with same supply chain used for top of economic pyramid. On the other hand, local organizations have good understanding on local community and market condition and thus develop native capability quickly than multi-national companies. Even, there have been better chances of 'South–south cooperation' which is defined by Japan International Cooperation Agency (2006) as '*A means of promoting effective development by learning and sharing best practices and technology among developing countries'*. The concept is put into practice by Sunlabob, where they train the Ugandan entrepreneurs about solar lantern business and help out to establish Sunlabob's franchise over there. Therefore, local organization can operate BoP business not only in domestic market but also transfer business model into other geographies.

6.2.2 Is it important to collaborate with government for BoP business?

GS collaborates with IDCOL (Infrastructure Development Company Limited) for implementing SHSs in off grid areas of Bangladesh. Due to collaboration with IDCOL, GS receives institutional grant and buy down grant, soft loans (for consumer financing), technical and logistic assistance. At the same time government of Bangladesh offers VAT (Value Added Tax) and import duty exemption for PV panel. In this connection, Gradl et al. (2008) mentioned that collaboration with government is one of the solutions for BoP business; which creates enabling business environment for private sectors by adapting favourable policies and providing incentives. Thus, collaboration between GS and IDCOL facilitate the success of GS's SHS program. On the other hand, Sunlabob is not getting any support from Lao government like GS. But, Rural Electrification Project of World Bank enjoys duty free export of PV panel along with huge subsidies and thus offers SHS in 'hire and purchase' model in less price than Sunlabob. Ultimately, World Bank's Rural Electrification Project ruins the rental SHS business of Sunlabob (Schroeter 2011). Further, Schroeter (2011) claims that GoL does not want private activities for decentralize RET implementation in off-grid areas as government feel that they can do better. Thus Sunlabob's failure to collaborate with government leads unsatisfactory result in their BoP business. So, it can be argued that collaboration with government is an important solution for BoP business.

6.2.3 How grants and subsidies help in BoP business?

In order to support renewable energy, governments can use different Public Financing Mechanisms-PFMs (R&D support, public-private fund, grant, soft loans, credit lines, carbon fund, incubators etc.) aiming to influencing the specific risk/ return profile of RETs (UNEP 2011). More simply, public financing mechanisms are used to mobilize the private sector investments by reducing the initial cost of RETs and; making RETs attractive and affordable to customers so that they can contribute to greening the energy sector ultimately (UNEP 2011). So, public financing mechanisms can be applied with BoP business models for electrifying off-grid areas.

In Bangladesh, IDCOL implements 'Solar Energy Program' financially supported by World Bank, GEF (Global Environmental Facility), GIZ (German Society for International Cooperation), German Development Bank-KfW, IDB (Islamic Development Bank), ADB (Asian Development Bank). Under IDCOL's implementation framework, GS receives buy down and institutional development grant to reduce the high initial cost of SHSs (IDCOL 2011). The grants and subsidies distributed by IDCOL to GS are equal to 12% of a total SHS cost (World Bank 2008). GS also receives soft loan from IDCOL, integrates the soft loans with their BoP business model and offer micro-credit to customers to buy SHSs in installments. Therefore, it can be argued that grants received from IDCOL reduce the initial cost of SHSs and offer of micro-credit increases the affordability of the customers. Also, Khan (2011) claims that financial support of IDCOL to POs (Partner Organizations) make the 'Solar Energy Program' successful. Actually, it can be said that financial supports from IDCOL help to attain economic sustainability and scalability of 'Solar Energy Program' implemented by partner organizations.

On the other hand, Sunlabob operates their rental SHSs business model independently without any notable supports from GoL and failed to scale up after defeated by subsidized World Bank's Rural Electrification Program. Therefore, it can be argued that financial supports (subsidies, grants, soft loans) facilitate the economic sustainability of BoP venture, expansion of RET business, opening up of previously closed market for RETs and commercialization of renewable energy. Therefore, these kind of financial supports are termed as 'smart subsidies' (London and Hart 2011). Finally, it can be said that subsidies and grants are helpful for BoP business.

6.3 Transition of RETs: Green Sprouts to Green Giants

In Bangladesh, GoB through IDCOL implements SHS and domestic biogas plants by providing financial assistance. Although, these green sprouts (small-scale and decentralized RETs) are alleviating energy poverty in off-grid rural areas, they have limited applications (lighting, TV watching, cassette playing, mobile charging,) and therefore can-not contribute to economic activities such irrigation during cultivation season or small cottage industries of rural people (Khan 2011; Phomsoupha 2011). In addition electricity supply is not continuous as like as grid (Sharif, 2011). Realizing this problem, GoL is planning to develop a 'feed-in-tariff' for encouraging electricity production in large scale in centralized way applying RETs (PV based power plant, biomass gasification plant etc.) to prompt up the economic activities in rural areas (Sharif 2011). Actually, 'feed-in-tariff' law ensures electricity purchase obligation for grid, minimum fixed price for electricity and nationwide cost settlement to remove regional disparities (Wustenhagen and Bilharz 2006). By formulating feed-in-tariff, GoB is preparing to encourage green giant for developing the economy of the country. But, electricity production from renewable energy is costlier than fossil fuel or natural gas; although external cost is low (UNEP 2011). Therefore, it could be challenging for a developing country like Bangladesh to manage the financial resources to encourage renewable based electricity production through 'feed-in-tariff' (Khan 2011).

In Lao PDR, government plans to hook up all the households of the country with grid electricity in long term (Phomsoupha 2011). Because, small-scale RETs such as SHS and PHP have limited applications and can-not contribute to economic activities. Even the price of per kilowatt of electricity is very high comparing grid electricity (Phomsoupha 2011.). Therefore, it can be argued that in future GoL would be brought all households under grid network to provide electricity in cheap way to promote economic activities. As, 99.83% of the electricity produced from large to small hydro plant in Lao PDR; which can be categorized as green giants (Smits and Bush 2010).

According to the future trend of the electricity generation, it can be concluded that policy makers and governments of Bangladesh and Lao PDR are intended to generate electricity from green giants to meet the electricity demand for improving living standard and attain economic opportunities.

6.4 Limitations of the BoP Business Models

GS and Sunlabob have been implementing SHSs through their business models with an intention to get rid of energy poverty. However, analysis of business model and experience sharing with GS's customers reveals that these business models have some limitations.

Firstly, Jonayed (2011) found that the service charge (interest rate) is high when customers want to buy the SHSs in installments. In 2010, service charges of GS were 4% and 6% of system's price when customers want to purchase in 2 and 3 years of installments respectively (Jonayed 2011). But in 2011, it has increased in to 6% and 8% for same installment period (Grameen Shakti, 2011). Therefore, it increases the purchase price of SHS. However, Gomm (2011) and Sharif (2011) argued that SHS implementation in off-grid areas of Bangladesh is a market driven approach; where lots of private organizations are engaged either in specific areas or in the whole country. Therefore, private organizations are allowed to take service charge to make profit. Customers are also free to find their SHS with affordable service charge from any of the private organizations near to their locality. Also, there is no restriction from IDCOL and government to private organizations for charging interest rate from customers and thereby open market economy exists there. However, Kamal (2011) mentioned that rate of service charge of GS would increase in future when IDCOL will phase out their grants. It can be argued that private sectors are charging interest rate to make profit in business but overcharging of interest rate may make business unsuccessful.

Secondly, GS supplies fluorescent tube and CFL (Compact Fluorescent Lamp) with their different SHSs (Grameen Shakti 2011; Islam 2011). Sunlabob distribute CFL lighting system for end users in 'fee for service' business model (Schroeter 2007). However, LED (Light Emitting Diode) lighting system is more energy efficient and has longer life span than fluorescent tube and CFL (European Commission 2011). Therefore, there is an opportunity to replace these lighting systems with LED arrays. But, they are not popular in developing countries as such Bangladesh and Lao PDR for some reasons: expensive than CFL, unavailable locally (Kamal, 2011). Sometime user's preference to lighting system may resist the application of efficient lighting. Such as Schroeter (2007) reported that Laotian do not consider LED as proper light. On the other hand, Khan (2011) argued that at least LED is better than kerosene lantern. Therefore, application of LED could increase the provision of using more appliances in same installed capacity of SHSs. Realizing the necessity, GS has started to manufacture LED arrays in one of their GTCs in Barisal district of Bangladesh (Kamal 2011). Along with lighting, off-grid people use SHS for mobile charging, watching television (usually black and white). But some other DC appliances are also introduced in Bangladeshi market such as LCD colour TV, solar panel integrated lighting systems (for home, restaurant and lawn), solar lantern, water pump, solar table fan etc. (MRECL 2011). In Lao PDR, Sunlabob introduced DC current solar fridge, freezer and water pump (Sunlabob 2011a). Therefore introduction of different DC current appliances increase the living standard and encourage economic activities in off-grid people.

Thirdly, Both GS and Sunlabob do not consider environmental management system yet within business models. According to the analysis of their business models, three types of environmental risk that could be

point of discussions: mercury pollution from CFL, acid and lead pollution from old batteries and electronic waste problem due to old PV panels. Firstly, replacement of CFL with LED and recycling of old batteries could manage the environmental risks associated with lighting system and lead acid battery. But the electronic waste problem of PV panels remains unsolved. Old PV panels (crystalline module, thin film module) cause air and water pollution (Cd and Pb leaching), loss of conventional resources (glass and steel) and loss of rare materials (Indium, Gallium, Germanium, Silver) (Monier and Hestin 2011). Therefore, recycling of old and decayed panels could reduce pollution; save conventional and rare resources; and cut-off the cost of producing new panels. Currently, glass extraction technology from old and used panels is practiced in Germany. Recycling technologies of other materials of PV panel such as Cd-telluride, aluminum are existed in laboratory (Waste Resources 2011). Therefore, it could be argued that recycling of PV panel is difficult and whole recycling process is not developed yet. In case GS, they have no plan up to now about how they will manage the old panels (Kamal 2011). Also, any plan has not been identified in case of Sunlabob. But recycling of old panel should consider in BoP business model for attaining environmental sustainability whether they would recycle it themselves or send to recycling plant.

Fourthly, it has been found from the field study in Bangladesh that most of the people using SHSs in Bangladesh are well-off rural family with monthly average income of 114 to 143 USD. Such evidences are also identified by Koirala et al. (2011) and Laufer and Schafer (2011) in case of India and Sri Lanka respectively. These income groups install SHSs as grid electricity is not available in their locality, although they are capable hook up their households with grid connection. Though, GS is implementing BoP business, there are also people live below identified monthly average income (see table 4.2). Therefore, it can be argued that existing BoP business model of GS is not able to reach poorer segment of the off-grid people. Because, buying SHSs is not affordable in comparison with their income. To bring these BoP people into electricity services, IDCOL has made some amendment their implementation mechanism. Right now they provide financial assistance to disseminate small SHSs such (10 Wp, 20 Wp); which was up to 30Wp earlier (Gomm 2011). As a result poor people, who can- not buy big system, can be able to purchase smaller one.

Besides, GIZ (German Society for International Cooperation) is planning to bring solar lantern for them in BoP market targeting the poorer portion of Bangladeshi population who do not have the money to buy small SHSs, (Gomm 2011). To explain the importance of solar lantern program Gomm (2011) decribes, '*18 million households are still not connected to grid; those who can-not afford SHSs. These are poorer households; still they are using kerosene lamp for lighting*'. So there is huge market potential for solar lantern in Bangladesh. Existence of this kind of market potentials in developing countries is also reported by Koirala et al. (2011). To bring these people under improved lighting services, GIZ is testing the feasibility of solar lantern to get the feedback from users and develop the supply chain. For this, they have distributed 4000 lanterns of four different models by employing 4 partner organizations of IDCOL and one private company (Gomm 2011). The basic concept behind the solar lantern program is to replace the kerosene lamp which ultimately provide better light to off-grid BoP people and reduce indoor air pollution (Gomm 2011).

Gomm (2011) mentioned that rural off-grid people spend 3.5 to 4 USD monthly for buying kerosene. Kerosene lamp users will spend the same amount of money to buy a solar lantern in hire and purchase/ dealer based model over 1-1.5 years of payback period. In this concern, they will utilize the same financial and implementation mechanism that IDCOL applies for SHS program (see figure 6.1). Further to maintain the good quality of lantern, GIZ has specified the standards (minimum 200 lumen light output and 2 years of warranty). Moreover, they will provide 10 USD buy down grant on purchasing price of 50 USD (approximately) to make the lantern affordable to customers and develop the market in future. However, the buy down grant will be phased out gradually. About, 120,000 units of solar lanterns will come in first batch; which will be produced in china and Indonesia. The financial support of buy down grant and development of supply chain of solar lantern business will be carried out by GIZ. Afterwards, they have planned to register the solar lantern program in CDM (Clean Development Mechanism) for further scaling up the program or providing more buy down grants (Gomm 2011). After analyzing the initiatives it can be said the solar lantern program will be able to reach the poorer segment of BoP and develop a potential market of solar lantern.

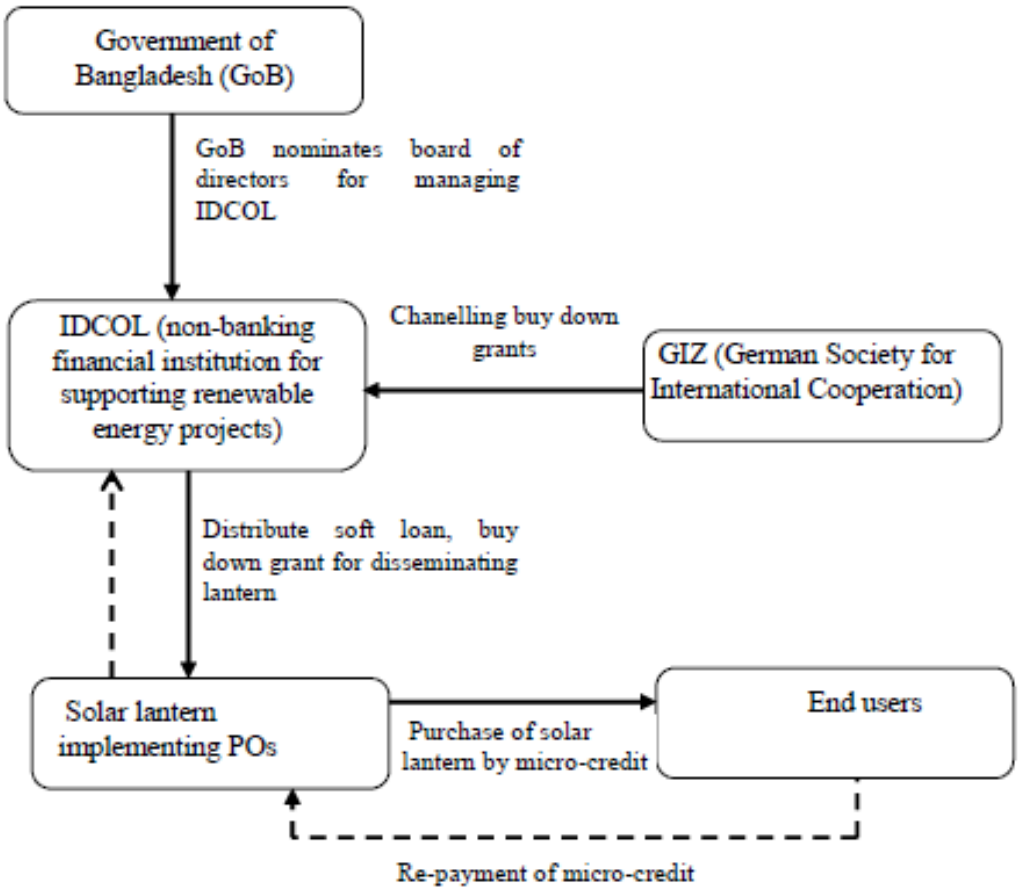

Figure 6.1: Proposed business model for solar lantern program under IDCOL (Author's own elaboration)

6.5 Can Social Business Model Solve the Energy Poverty?

Analysis of GS's BoP business model reveals that well-off off-grid people Bangladesh of are the main customers of SHS. However, new initiatives of solar lantern can bring those portions of BoP who can afford improved lighting instead of kerosene lamp with same monthly energy expenditure. Moreover, BoP business should attack poorer segment such as ultra-poor population. Greeley and Rabeya (2005) explicitly coined the term 'ultra-poor' and defined as '*who have less than 10 decimal of land property; earn by day labour, begging, domestic aid; no productive asset; children of school going age taking paid work; no adult active male member in the family'*. This group of people spends 80% of their income for food but can-not meet 80% of their calorific requirement (Greeley and Rabeya 2005). They are mainly supported by government and international organizations round the year under different programs[56] (WFP 2011). Therefore, it can be argued that they do not have enough money even for buying kerosene. So, switch to SHSs or solar lantern is nothing but a dream for them. That's why market oriented BoP business model may not be successful for these group of people. In this regards, social business model could be one of the possible solutions.

Social business is a type of business where business is done to attain social objectives (eg. alleviation of energy poverty) than making personal profit. Social business believes in cost recovery (no loss no dividend) to make the business self-sustaining. In this business, investors could withdraw investment but not the share of profit. Thus, profit generated in social business would be used for further expansion of business or to attain another social objective (Yunus 2010; Dalsace and Menasce 2011). So the concept of social business could bring robust solution for BoP in two ways. Unlike traditional profit maximizing business, there will be no competition for personal profit maximization. So BoP can get SHSs or solar lantern with more affordable price than BoP business model. Secondly, generated profit of social business can be used for penetrate poorer part of the society by adopting different innovative approach such as long-term loan with small interest for solar lantern. Finally, it would be a sustainable approach for alleviation of energy poverty as because, social business of energy poverty alleviation, inherits a social objective, maintain economic sustainability in 'no loss no dividend' manner and protect environment by replacing kerosene. Besides, due to social motivation of the business, it can be able to gain more trust and confidence of the people.

Although, concept of social business could provide better solution for BoP, tapping of financing sources of social business is challenging. However, grants and donation from international agencies (GEF, GIZ, ADB, SNV etc.) for reducing energy poverty could provide financial resources to social business for disseminating RETs. Finally, it can be argued that social business model promote social objective through business while BoP business model encourage market based approach to alleviate poverty. But it can be said that introduction of social business could make BoP business more competitive and responsible for poor people. Because, social business emphasizes social objective than profit-maximization.

[56] Vulnerable Group Feeding-VGF, Vulnerable Group Development-VGD, Open Market Sales-OMS, Cash for Work-CFW, Food for Work-FFW

6.6 Chapter Findings

Development of successful BoP business model requires different BoP solution approaches to overcome the market constraints by making collaboration with market actors. In this concern, the case studies on GS and Sunlabob's business models have come up with some lessons which could be useful for establishment of Green Leap business models. Firstly, local organizations can develop successful BoP business for implementing RET for alleviating energy poverty due to better understanding about local communities and conditions. But, care should be taken during the creation of market ecosystem so that it can solve out all the market constraints. Secondly, government can play role for developing renewable energy by providing supportive policies and institutions. Therefore, collaboration with government for initiating BoP business is essential to attain favourable regulatory environment and lead to successful BoP business model. Finally, implication of PFMs (subsidies, grants and loan) in BoP business model may not go with the 'market oriented approach' of BoP concept; however, it can increase the affordability of customers, reduce high upfront cost of RETs, increase the economic sustainability of the BoP business, develop the renewable energy market and open up the previously closed market.

Besides, case studies on GS and Sunlabob's business models have explore some opportunities for improving the business models of SHS implementation such as application of energy efficient lighting system and appliances; and introduction of environmental management for managing old CFLs, batteries and panels. Also, it is found that existing business of GS implements SHS at top of base of the pyramid. Therefore, more innovative BoP business model is required to alleviate the energy poverty at the lower part of BoP. In this concern the concept of social business model could guide the solution to alleviate energy poverty of poorer segment of population in a sustainable way.

7. Conclusion

7.1 Conclusion

At present, 1.4 billion people do not have access to electricity and most (85%) of them live in rural areas of developing countries. Notably, they are facing energy poverty due to lack of modern, affordable, reliable, clean and safe energy services and thus it causes poverty penalty by paying more in comparison with their wealthier part of society for same energy services. Modern energy access for theses energy poor depending on existing national and international policies would be difficult due to requirement of large investment; and inefficiency and bureaucracy of government. In addition, connecting those remote and rural areas with grid electricity where energy poor live; are not feasible for various practical reasons such as far away from existing grid, large investment of grid extension, transmission and distribution loss, difficult terrain, sparsely populated areas, low load density and possibility of low revenue generation. Therefore, new and innovative approaches are required to hook up all the energy hungry BoP households with electricity services. 'Green Leap' business model has brought a new market oriented approach to energy alleviate poverty. Based on two case studies (Grameen Shakti, Bangladesh and Sunlabob, Lao PDR), the current research work is carried out to identify-'How BoP business model can alleviate energy poverty?' To answer the above mentioned problem statement the following working questions are set:

5. How BoP Business model contribute to alleviate energy poverty in developing countries?
6. How Grameen Shakti's (GS's) business model alleviates energy poverty in Bangladesh?
7. How Sunlabob's business model alleviates energy poverty in Lao PDR?
8. What are the learnings from the studied business models?

Each working question mentioned above is split in to sub-questions and answered as findings in corresponding chapters. In this section, all findings are presented together in order to answer the problem statement.

The emergence of the BoP (base of the pyramid) approach was inevitable due decade's long failure of development communities and governments of developing countries to eliminate poverty in its multi-dimension. Practically, BoP offers broad and diversified range of business models developed by or in collaboration with privates sectors (multinational companies, local private enterprise, social enterprise etc.) aiming the BoP market of USD 5 trillion by engaging BoP people as consumers, producers and co-creators of business. In doing successful BoP business, native capability and embedded innovation characteristics of business models need to be assured, which can be achieved by following BoP business protocol. Market ecosystem results; when market conditions (constraints) interact with market actors. Therefore, design of market ecosystem for BoP business model is essential to overcome the market constraints with the assistance of BoP business solution approaches. Again, BoP business of technology diffusion such as solar home system implementation can be examined as system of innovation to explore how successfully they integrate the building blocks (technology and related knowledge and skills; networks of actors and institutions) of

innovation. Moreover, BoP impact assessment framework and triple bottom line assessment evaluate the success of BoP business model by identifying the impacts of business on customers and communities; and sustainability respectively. Therefore, for this study, SHS business models of Grameen Shakti and Sunlabob are analyzed in terms of BoP business protocol, system of innovation, market ecosystem, BoP impact assessment framework and sustainability assessment.

BoP theorists (Clay Christensen and Stuart L. Hart) conceptualize 'Green Leap' business model for commercializing small and distributed green technologies (Green Sprouts) such SHSs, wind home system, Pico Hydro Power, domestic biogas plants through BoP business models to leapfrog the unsustainable technology practices and attain economic and environmental benefits such as no fuel cost, supply electricity at the point of generation, accessible to remote rural areas, cost effective and no or very less negative externalities of electricity production. According to 'Green Leap' business, decentralized and small scale renewable energy technologies such as solar home systems can alleviate energy poverty by bringing modern, affordable and reliable electricity access to poor through bottom up BoP business model. Realizing the business opportunity of 433 billion USD in BoP energy market, many multinational companies, large national companies have experimented 'Green Leap' business model for eliminating energy poverty. However, review of related literatures confirmed that four types of 'Green Leap' business models of off-grid electrification are adapted by private sectors; which include: dealer based, built–own–transfer, fee-for-service/ rental service and progressive purchase method. Among the business models, adaption of dealer based 'Green Leap' business model is higher than others. In addition, literature analysis revealed that local organizations of developing countries participate more in 'Green Leap' business venture due to inheriting native capability. In this connection, cases (Grameen Shakti and Sunlabob) of this study are also adapted business models for implementing solar home systems in rural areas. Therefore, case studies on both organizations would reveal whether they have adapted 'Green Leap' Business model or not. For that, cases are investigated in broad aspects explained how their business models are eliminating energy poverty in existing business environment of renewable energy sectors of respective countries.

Case study of Grameen Shakti's solar home system business requires depth investigation on renewable energy technology practice and BoP market information of Bangladesh with a motive to identify the best practiced renewable energy technologies and BoP market constraints which are essential for market ecosystem analysis. Firstly, analysis of renewable energy technology related literatures confirms that solar home systems, improved cook stoves and domestic biogas plants are best practiced renewable energy technologies in Bangladesh. Solar home systems is the most popular small scale and decentralized renewable energy technology (Green Sprout) among rural people; as because, 53% of country's population (actually the rural people) is not connected by the grid yet. So, they prefer solar home systems for electricity services during night-time. Moreover, user friendliness, requirement of low maintenance, government financial support for solar home systems projects make it more attractive to off-grid people. Due to energy saving characteristic of improved cook stoves (up to 50%) comparing traditional cook stoves, they have

demand to people. Besides, domestic biogas plants are utilized in many rural households having good source of biomass (cow dung, poultry waste). But, two other factors stimulate people to choose domestic biogas plant: source of clean cooking fuel and government supports (subsidy and soft loan) to end users to construct domestic biogas plants.

Secondly, statistics is not available on BoP market constraints. However, analysis of income statistics proves that all most all the Bangladeshi fall under BoP when their incomes are compared with BoP income threshold (<3000USD in local purchasing power parity). Inspite of remaining in energy poverty, energy expenditure is higher for rural people than urban inhabitant's and proves the existence of poverty penalty. In case of financial services, BoP people get easy access to microcredit facilities than insurance and banking services (savings, deposits, and credits) as 540 NGOs are operating microcredit programs all around Bangladesh. In case of physical infrastructure, the situation is not satisfactory for Bangladesh. Because, only 30% of total roads are paved and 39 % of rural population has access to all season roads (roads that are access able to around the year by all means of rural transports) whereas only 27.9% of population have mobile phone subscriptions at best.

In case of regulatory measure, Government of Bangladesh (GoL) has clear target to meet 5% and 10% of power demand from renewable sources within 2015 and 2020 and provides some limited but specific facilities to private sectors for renewable energy technology business. Firstly, government of Bangladesh has established Infrastructure Development Company Limited to provide financial supports (soft loans, grants, subsidies) to private sectors for implementing renewable energy technologies in rural areas and secondly, import duty exemption facility for PV panels. Despite of these incentives, government of Bangladesh has yet to establish an independent authority named- 'Sustainable Energy Development Authority (SEDA)' for planning and development of renewable energy coordinating all stakeholders by approving the National Renewable Energy Policy (NREP) in parliament. Although, any reliable information is not found on customer knowledge and skill level; analysis of market information confirms the existence of market constraints (lack of customer information's, unsatisfactory physical infrastructure, insufficient financial services except access to microcredit and weak regulatory environment); which also indicates the informal status of market economy of Bangladesh.

Case study on GS (Grameen Shakti) reveals that they commercially install solar home systems to rural people either by selling directly with 4% discount or with soft credit to make it affordable, provides 3 years after sales maintenance of the system and trains customers at GTC (Grameen Technology Center) so that they can take care of their own system (cleaning of solar panel, cleaning of battery, checking of battery electrolyte, meaning of charge controller's indicator etc.). Soft credits available from Grameen Shakti for purchasing solar home systems are only for 2 and 3 years with 6% and 8% of service charge (in flat rate) respectively. Also, Grameen Shakti offers small solar home systems (40 and 50 Wp) under so called Micro Utility model of 36 monthly installments, where people can share the load of SHSs. Besides, Grameen

Technology Centre trains rural woman on manufacture and repair of solar accessories such as charge controller, AC-DC converter, lampshade, CFL circuit repair etc. So, Grameen Shakti implements dealer based business model; which is a sustainable rural off-grid electrification option. Analysis of Grameen Shakti's business model in lens of BoP business has identified five features; which are compatible with BoP business model.

Firstly, business model of Grameen Shakti was not formulated according to BoP protocol as it was established before emergence of BoP concept and protocol. So the co-creation and native capability was not ensured during the formation of business model. However, setting up Grameen Technology Centre ensures co-creation of business afterwards where community people are not only consumers but producer and part of business model co-creation.

Secondly, Grameen Shakti has developed an effective market ecosystem applying BoP business solutions to overcome the identified BoP market constraints. Adapted business model of GS overcomes the constraint - 'lack of market information' in two ways: Grameen Shakti, as a sister concern of Grameen Bank inherits the Grameen Bank's long experience of working with rural communities; and social engineers of Grameen Shakti maintain good communication with customers and rural people. Grameen Shakti invests financial and technical resources to launch Grameen Technical Centre as part of business model; where customers get training to improve knowledge and skills on solar home system. Collaboration between Grameen Shakti and government makes the business environment favourable by providing financial supports (soft loan, grants) from Infrastructure Development Company Limited and exempting import duty for PV panel. Consumer financing is made available to purchase solar home system by adapting microcredit scheme in business model and collaborating with government. Also, constraint of physical infrastructure is overcome by integrating after sales services agreement for solar home system with business model and under this agreement Grameen Shakti's employees visit customers house monthly for repair and maintenance.

Thirdly, Grameen Shakti's business model is an innovative system for solar home system implementation because, they install solar home systems (technology); train customers, women and own staff on solar home system (knowledge and skills); develop collaboration with end users and Infrastructure Development Company Limited (network of actors) and offer microcredit to customers (institution).

Fourthly, BoP impact assessment of Grameen Shakti's business has found that implementation of solar home systems in rural areas bring changes in economics (solar lighting at competitive price, income generation, access to credit etc.), capabilities (educational development, improve living standard, use of local resources) and relationships (building social network, building trust and confidence and improve social status) among the customers. In broader aspect it also changes community's economy, capabilities and social relationship by bringing economic and social development, social networking and close interaction with ecosystem. However, some negative changes may occur such as increase of debt level of customer due to high interest

rate by Grameen Shakti and social exclusion when women do not participate in trainings of Grameen Technology Centre due to cultural and social barriers.

Fifthly, Grameen Shakti's solar home system program is sustainable regarding triple bottom line (economy, environment and society) which means problems solved by the intervention should be more significant than new problem arisen. Sustainability assessment of Grameen Shakti's business model has identified that it creates significant positive impacts in economy (electricity in competitive price, income generation, employment opportunities, increase productivity), and society (increase living standard, rural development, increase social status). It may be also disadvantageous in economy (reduction of kerosene sell in village shop, reduction of expenditure in other basic needs) and society (mental conflicts between SHS s user and non-users) as well. The business of Grameen Shakti has positive impacts on environment by reducing CO_2 and indoor air pollution. In future, huge amount of old and decayed PV panels could create electronic waste problem, if they were not recycled. Finally, all identified features of Grameen Shakti's business model confirm that Grameen Shakti is successfully adapted BoP business model (or Green Leap business model) with a commitment to alleviate energy poverty.

Case study on Sunlabob of Lao PDR reveals that renewable energy technology practice and BoP market information varies compared to Bangladesh. Firstly, various small scale and decentralized renewable energy technologies are practiced in rural areas of Lao PDR such as solar home systems, hybrid village grid, mini grid, community PV, domestic biogas plant, micro-hydro and pico-hydro power. Except biogas plant, other renewable energy technologies are utilized to generate electricity. Among the available renewable energy technologies, application of solar home systems is growing rapidly in off-grid areas for electricity services. Because, availability of solar radiation, user's friendliness and World Bank's subsidy make the technology popular to off-grid people. Besides, pico-hydro power has high demand on off-grid people. Because, it is cheap even without subsidy, low operation and maintenance cost, low complexity of technology and availability of spare part in rural areas. Therefore, SHS and PHP constitute the best-practiced RETs in Lao PDR.

Analysis of market information of Lao PDR ensure the presence of market constraints: lack of customer information, lack of customer's knowledge and skills, lack of financial services, weak regulatory environment and lack of physical infrastructures. The existence and extent of BoP market is easily identifiable in Lao PDR due to having average per capita income of 880 USD/year which is well below the BoP income benchmark and further, 27.6% of total population (6.3 million) lives under poverty line. However, statistics is not available on energy expenditure of the BoP people. Not only that, knowledge and skill level of Laotian on RETs is low due to out-dated education system and unfamiliarity with renewable energy technologies such as solar home systems. Also, financial services are limited for poor people and only 7% of poor people have access to financial services. It also notable that only ANZ Grindlays bank finances to private sectors for renewable energy project. Physical infrastructure of Lao PDR is unsatisfactory

as because, 13% of total road network is paved and only 40% of rural people have access to all season road. Moreover, 33% of population subscribes mobile phone connection. In case of regulatory environment, Lao PDR is yet to develop any specific policy on renewable energy development. Recently, they have drafted National Renewable Energy Development Strategy-2010. However, the Law on Electricity provides the opportunities to private sector for implementing small scale renewable energy technology project in off-grid areas. However, Drafted renewable energy development strategy-2010 would offer some incentives (exemption of import duties, low personal tax and profit tax, long term investment contract, provision of hiring foreign experts) to private sectors; when it will be approved by parliament.

At present, government of Laos has no institutional set up for renewable energy development, although, they have temporary implementation mechanism for renewable energy technologies called Village Off-grid Promotion and Support under Ministry of Energy and Mines; where small scale Provincial Energy Supply Companies (PESCOs) can operate business as implementer than independent private sector. Moreover, renewable energy initiatives of Lao PDR are carried out by a set of stakeholders such as government (such as Ministry of Energy and Mines), financial organization (such as World Bank, Asian Development Bank), private sector organizations (such as Provincial Energy Supply Companies, Sunlabob), research organization (National University of Laos, Laos Institute of Renewable Energy) and end users. Participation of private sector is in early stage of development due to lack of business friendly rules and regulations.

Case study on Sunlabob's business model uncovers that they implement solar home systems program in the off-grid villages; when the villagers approve the project and then, village energy committee signs contract with Sunlabob on behalf of villagers. Afterwards, nearby Sunlabob authorized franchise installs solar home systems in the villages and rents out to village energy committee. Finally village energy committee sells solar electricity to villagers on monthly basis. Village energy committee is a kind of village institution who manages the energy requirements of the customers, collects monthly bills, manage defaulter and monitor the work of village technician. The villagers and village energy committee select village technician, who operates and maintains the SHSs. Village technicians are trained by Sunlabob's franchise. If the village technicians fail to sort out any problem, nearby franchisee solves the problem. According to sustainable off-grid electrification business model, Sunlabob implements 'rental/ fee for service' model for the solar electricity services. Besides, analysis of Sunlabob's rental business model identifies some characteristics that fit with Green Leap business model.

Firstly, Sunlabob didn't practice BoP protocol to establish the business model. But, they integrate the native capability and embedded innovation through engaging people as members of village energy committee, village technician. Also participation of villagers in selecting village energy committee and village technician facilitates the co-creation of the rental business model.

Secondly, Sunlabob has developed a market ecosystem for the business to overcome identified constraints applying solutions of BoP business. Sunlabob collaborates with communities to engage local people as

village energy committee, village technicians and franchisees, which ensure the flow of customer's information. Financial investment in training upgrades technical knowledge and skills of village energy committee, village technicians and franchisees. Government collaborates with Sunlabob only in selecting projects area for off-grid electrification projects, but do not provide any policy or institutional support. Also, Sunlabob didn't apply any solution approach to bring rural people into financial services because they sell electricity on monthly basis rather than solar home system. They have developed a network of franchises at provincial level by adapting rental business model and investing financial and technical resources to overcome the market constraint of poor physical infrastructures.

Thirdly, rental business model of Sunlabob is an innovative system for implementing solar home systems; because it addresses the technology (solar home systems), knowledge and skill (franchise, village energy committee, village technicians) and institutions (such as village energy committees) and network of actors (end users, village energy committees, franchises, village technicians) effectively. But finally, it becomes uncompetitive due to highly subsidized SHSs program of World Bank.

Fourthly, according to the result of BoP impact assessment, rental solar home system business of Sunlabob has both positive and negative impacts (economic changes, capabilities changes and relationship changes) on franchisees, customers and communities. The realized positive changes for customers include improvement in living standards, increased social status, access to telecommunication and trusted relationship among customers, village energy committees and Sunlabob. But the important negative economic impact on customers is higher monthly electricity bill than World Bank lead subsidized solar home system program. Besides, franchisees attain some changes in economy, capabilities and relationship; which includes: employment opportunities, income generation, technical knowledge and skill developments, development of business network. Local communities also obtain social development, economic improvement, social institutional such as village energy committee.

Fifthly, according to sustainability assessment, Sunlabob's rental business model is not successful. Because, it can-not provide solar electricity in affordable price and thus the business model turns into an economically unsustainable one. However, it can bring some income and employment opportunities. Sunlabob's business model has positive social impacts identified by BoP impact assessment, while it has some negative impacts also such as: mental conflicts among solar home system users and non-users, social harassment etc. As a renewable energy technology, solar home system affects the environment positively. But, failure to recycle old batteries and panels in future may cause mercury and electronic waste pollution. However, Sunlabob's rental business model could be a successful BoP business model for alleviating energy poverty. But due to unfair competition of highly subsidized World Bank project it failed to attain the economic sustainability. Thus it becomes unsuccessful Green Leap business model not for being faulty business model but for non-cooperative regulatory environment of Lao PDR.

The case studies on GS and Sunlabob's business models can guide about two aspects of 'Green Leap' business model. Firstly, local organization can operate sustainable BoP business to alleviate energy poverty due to sound understanding on local market condition and communities which ultimately influence native capability and co-creation of business. Secondly, collaboration with government is important for policy, financial and institutional supports from the respective government. For launching BoP business, success of private sectors depends not totally on effective development of market ecosystem but also cooperation from the regulatory environment of renewable energy sectors.

7.2 Recommendations

During the discussions on regulatory environment of Bangladesh and Lao PDR in chapter 4 and 5, some weakness are identified that demand solution to create a business friendly environment for private sectors. Also, analysis of business models of GS and Sunlabob found some limitations that need to way out for sustainability of business. Therefore, some recommendations are suggested both for improving the regulatory environment and private sector's 'Green Leap' business model.

Recommendations for improving regulatory environment

1. Both Bangladesh and Lao PDR are yet to approve their national renewable energy policy. So, approval of renewable energy policy is important for supporting renewable energy development.
2. Any independent authority for developing and planning renewable energy is neither available in Bangladesh nor in Lao PDR. Therefore, independent authority should be established for planning and coordinating the renewable energy activities.
3. In Lao PDR, there is no incentive for renewable energy based private sectors. Therefore, government of Lao could introduce some incentives (such as exemption of VAT and import duty on renewable energy technology) like Bangladesh for encouraging the privates sectors.
4. In current situation, there is no provision for private sectors to work with GoL in large scale 'Green Sprout' based renewable energy technology implementation projects due to limitation of existing implementation mechanism. Adaption of Infrastructure Development Company Limited's renewable energy technology implementation framework could provide more space for large Laotian private company (such as Sunlabob) to work with Lao government.
5. Environmental management of system of solar home system program should be taken into consideration by both the governments of Bangladesh and Lao PDR due to manage the electronic waste pollution from old PV panels, lead and acid pollution from battery and mercury pollution from CFL.

Recommendations for business model:

6. GS and Sunlabob should promote and introduce the application of energy efficient appliances (LED lighting system, DC current TV, fridge, fan etc.) with their customers. Utilization of energy efficient appliances gives the opportunity to use more appliances in same installed capacity of SHS.

7. Sunlabob should establish technical centers like GS's Grameen Technology Center for manufacturing solar accessories as they import solar accessories currently. It will reduce system cost and add another point to ensure the co-creation of business model.
8. Private sector should innovate new business model to alleviate energy poverty for the people living at the lower part of BoP. German Society for International Cooperation proposed solar lantern program in Bangladesh could be an example in this regard.
9. Renewable energy based private sectors of developing countries should developed a network with a view of 'South-south-cooperation' for learning and sharing of experiences on 'Green Leap' business model.

Table 7.1: Recommendation for government and privates sectors

Suggested recommendations for improving regulatory environment and business model		Actors
Regulatory environment	Approval of national renewable policy	GoB, GoL
	Establishment of independent renewable energy development authority	GoB, GoL
	Incentives for private sectors	GoL
	Effective institutional framework for RET implementation	GoL
	Development of environmental management system for SHS program	GoB, GoL
Business model	Introduction and promotion of energy efficient appliances with SHS	GS, Sunlabob
	Establishment of technology center	Sunlabob
	Innovation of new business model for poorer segment of BoP	GS, Sunlabob
	Networking among 'Green sprout' based renewable energy companies	GS, Sunlabob

Source: Author's own elaboration Note: GoL-Government of Lao PDR
GoB-Government of Bangladesh

7.3 Perspective

BoP market is consists of population of different income segments. So, 'Green Leap' business that operates at the top of base of pyramid may not be effective for further low income BoP; where poverty is more extreme. Therefore, new and more innovative business models are required to penetrate the poorer portion of BoP with a vision to alleviate their energy poverty. Social business could be one of the solution to alleviate energy poverty in which business is operated in 'no loss-no dividend' manner with a mission to attain social objectives. Thus, approach towards more sustainable business solution can bring affordable, reliable and modern energy access to 'poorest of the energy poor'.

In broader perspective, application of 'Green Sprouts' in off-grid rural people reduce the burden of greenhouse gases emission and lead towards sustainable energy development by greening the energy sector. Also, rapid expansion of 'Green Sprouts' lead the innovation and market development of energy efficient DC appliances in developing countries. Then, the concept of sustainable energy development comes into practice more robustly due to application of energy efficient appliances with renewable energy technologies.

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