Sustainable energy for Development: Access to finance on renewable energy and energy efficiency technologies for Bangladesh

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12 March 2014

ACKNOWLEDGEMENT

The research paper "Sustainable Energy for Development (SED): Access to Finance on Renewable Energy (RE) & Energy Efficiency (EE) Technologies for Bangladesh." This study was partially financed under the research scheme of the Comilla University. We would like to acknowledge the support provided by the Comilla University.

This research is to prepare a strategy and action plan for removal of barriers to accessing financing for EE/RE technologies, lack of familiarity of commercial banks and such institutions with these technologies, communication gap between financing institutions and potential borrowers of this sector namely, households, businessman and manufacturing industry owners. To explain the research point of view of banking and financing institutions and the risks associated with renewable energy and energy efficiency projects. The objective of the empirical research is how could be used renewable energy and energy efficiency technologies to consideration of future generations demand for sustainable energy for development in Bangladesh?

The authors are grateful to anonymous referees who have detailed idea and comments. I feel deep sense of pride to express my sincere appreciation and indebtedness to M. Ehsanul Haque, Advisor, Financial Excellence Limited (FinExcel). Now he is Managing Director & Chief Executive Officer (CEO) at Mercantile Bank Limited, Dhaka, Bangladesh for his suggestion and guidance in preparing the paper, who always blessed, inspired and sacrificed a lot in the long process of building my academic career, which can never be repaid. And I also grateful to household members of Mohakhali and Niketan area, some commercial banks, and some students of various university of their field survey at various phases in the process of preparing the research.

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ACRONYMS

ADB	Asian Development Bank
ADB	Asian Development Bank
BB	Bangladesh Bank
BBS	Bangladesh Bureau of Statistics
BER	Bangladesh Economic Review
BPDB	Bangladesh Power Development Board
CDM	Clean Development Mechanism
CF	Consumer Financing
CFLs	Compact Fluorescent Lamps
DNCC	Dhaka North City Corporation
EE	Energy Efficiency
ETP	Effluent Treatment Plants
GDP	Gross Domestic Product
GoB	Government of Bangladesh
ICS	Improved Cooking Stoves
IDCOL	Infrastructure Development Company Limited
LED	Light-Emitting Diode
LGED	Local Government Engineering Department
MPEMR	Ministry of Power, Energy & Mineral Resources
NGOs	Non Government Organisations
PPP	Private Public Partnership
PV	Solar photovoltaic
RD	Research and Development
RE	Renewable Energy
REB	Rural Electrification Board
RPS	Renewable Portfolio Standards
RPS	Rice Parboiling Systems
SED	Sustainable Energy for Development
SEDA	Sustainable Energy Development Authority
SFYP	Sixth Five Year Plan
SREDA	Sustainable and Renewable Energy Development Agency
SWP	Solar Water Pumps
WB	World Bank
WTP	Willingness to Pay

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EXECUTIVE SUMMARY

Bangladesh will achieve considerable success in acceleration of economic growth of course need for sustainable energy for development (SED). Renewable or 'green' energy is now at forefront of the country's priorities for environmentally sustainable economic progress. The Power Division under the Ministry of Power, Energy & Mineral Resources (MPEMR) has declared a "Renewable Energy Policy of Bangladesh" and under the Companies Act, 1994, the GoB, is establishing an institution named "Sustainable Energy Development Authority" (SEDA).

At present Bangladesh takes the different financing models that have been developed and tested for renewable energy projects in urban and rural communities and energy efficiency improvement projects. Bangladesh Bank (BB) has developed an incentive scheme for concessional refinancing for small solar energy, bio-gas plants and Effluent Treatment Plants (ETP). These are recent initiatives on their part and Banks are yet to take full advantage of such concessional refinance.

To analysis primary data collected for used cross sectional study to be considered about allied factors for renewable energy especially *solar energy*. A structured questionnaire was prepared in the light of the objectives of the study that was filled up by direct interview. The multivariate techniques viz., multiple logistic regression models, will be used to identify the inputs significant for sustainable energy for development in Bangladesh that is accelerating economic growth of a nation. Software packages *Eviews - 5.1* have built-in routines to estimate the logit model at the individual level.

Logistic regressions have been presented with the dependent variable as an indicator of the probability of being in generate RE and EE. Dependent variables dummy of RE and EE (= 1, if a generate RE and EE is full, otherwise under) have been included. The expected sign of explanatory variables coefficients are positive and or negative respectively. Thus, other things remaining same, if high cost RE/EE technologies up to become low cost, each stakeholder will purchase RE/EE technologies. However, together all the regressors have a significant impact on the log of RE/EE, whose *p-value* is about 0.0000, which is statistically significant.

We are looking at different sources of financing on both RE and EE investment decisions. Overall, financial institutions will aim to create a package that includes the total finance amount and the repayment terms, the interest rate, the repayment schedule and any guarantees or securities. When successful, these new approaches could be capable of triggering the involvement of commercial banks. Point of view of banking and financing institutions and risks associated with renewable energy (RE) and energy efficiency (EE) technologies for sustainable energy for development (SED).

Keywords: Renewable Energy, Energy Efficiency, Sustainable Development

JEL Classification: Q26, Q56

I. INTRODUCTION

I.1 Background of the study

Bangladesh is facing serious energy crisis with adverse impact on its growth potential and livelihood of people. The country is far behind to realize 8% annual growth in energy supply which is needed even to maintain the current level of annual Gross Domestic Product (GDP) growth rate of 6% (BBS, 2011). Because of the severity of the power crisis, the Government has been forced to enter into contractual agreements for high-cost and temporary solutions. The longer term strategy embedded in the Sixth Five Year Plan (SFYP) of Bangladesh aims to promote low-cost, sustainable expansion of power generation, transmission, and distribution capacity.

Bangladesh government as part of its energy policy is forging ahead in developing structures and policies which facilitate Private Public Partnership (PPP) in the development of renewable energy and energy efficiency services across the country. In an energy starved, densely populated, industrial and agricultural country like Bangladesh, pursuing 6% to 7% growth, the long term objective will have to be sharply focused on sustainable development in the energy sector (BBS, 2011).This should be knowledge based, efficient and where the business community, financing institutions, Bangladesh Bank, Government of Bangladesh (GoB), and multilateral agencies work towards the common objective of harnessing Renewable Energy (RE) & Energy Efficiency (EE) technology.

The Power Division under the Ministry of Power, Energy & Mineral Resources (MPEMR) has declared a "Renewable Energy Policy of Bangladesh"; this document outlines the objectives, institutional arrangements, resource technology, program development, investment, fiscal incentives and regulatory policy. Under the Companies Act, 1994, the GoB, is establishing an institution named "Sustainable Energy Development Authority" (SEDA). This will be a focal point for 'Sustainable Energy' development and promotion which are renewable energy and energy efficiency. SEDA Board will comprise of representatives of stakeholders like the business community, academics and representation from Bangladesh Solar Energy Society, Non-Government Organisations (NGOs), financial institutions and implementing agencies.

Multilateral Agencies and development partners like World Bank, Asian Development Bank (ADB), GiZ and KFW are primarily active in the RE/EE sectors. Solar photovoltaic (PV) systems, Biogas plants are being implemented through Infrastructure Development Company Limited (IDCOL). Rural Electrification Board (REB), Local Government Engineering Department (LGED), and Bangladesh Power Development Board (BPDB) are also scaling up Solar PV systems as well with the assistance of development partners. NGOs and Private Organizations are implementing solar energy program as partners of these Government Agencies. The major areas which have gathered momentum are domestic solar PV systems and domestic biogas plants. Other areas gaining popularity are Improved Cooking Stoves (ICS), Rice Parboiling Systems (RPS), Commercial Bio-Gas Plants and Solar Water Pumps (SWP).

- Solar PV systems used throughout the country in off-grid rural areas, is estimated at about 1.15 million household-level installations.

- Biogas mainly from animal and municipal wastes is a promising renewable energy resource for Bangladesh. Presently there are more than 25,000 households and village-level biogas plants in place throughout the country.
- Commercial bio-gas plants primarily from birds and animals waste is gaining impetus.

Efficient use of energy should be seen as a moral issue - to use available energy resources in consideration of future generations. Since the energy system plays a vital role in interrelated economic, social, and environmental aims of sustainable human development, energy efficiency improvements is crucial to climate change and sustainable development (Hordeski and Michael, 2003). The challenge to develop climate-friendly and socially acceptable methods for supplying the ever increasing demand for energy services in Bangladesh will be managed by:

- Developing energy efficient markets, simultaneously with the promotion and use of innovative technologies.
- Developing local energy efficiency expertise in the finance sector, expanding technical expertise, energy efficiency solutions and service providers.

The underpinning thrust of the SFYP is to spread and develop renewable energy, which also includes energy efficiency. The plan noted the following benefits in the use of renewable energy:

- Supply of raw materials for power generation is potentially infinite
- Operational cost is low although initial investment is comparatively high
- Technology is easy and portable
- People living separately in places away from the main land can have access to power and energy facilities
- Future energy security is ensured
- Renewable energy is environment friendly (i.e. green energy)

Investment costs of renewable are higher compared to fossil fuel alternatives. In the short run marginal cost is high, but in the long run marginal cost is low. However, this option becomes economies of scale when externalities like environmental cost, health hazards, labor cost and lower operating cost are taken into consideration. In Bangladesh the development and efficient utilization of renewable energy and energy efficient resources is low and yet to assume commercial dimensions. There is urgency among stakeholders to determine and harness the economic potential of renewable energy and energy efficient resources.

Energy efficiency and renewable energy are said to be the twin pillars of any sustainable energy policy. It has a national security benefit as it reduces energy imports (i.e. increase government reserves) and gradually diminishing the rate at which domestic energy resources are depleted. Energy savings will reduce Bangladesh's energy supply/demand gap and mitigate adverse effects on climate change. There is a global effort to institutionalize energy efficiency by reducing wastage and operational costs, savings of scarce resources and reducing carbon emissions. There is an observed economic and social benefit to society.

The following stake holders' involvement is necessary to enable a sustained and continuous expansion of RE/EE technologies:

- Development Institutions/multilateral agencies for strengthening the regulatory framework assist in awareness creation, technology transfer and financial stimulation.

- Government machinery including Central Bank (Bangladesh Bank) and Public sector participation for creating models, policy formulation, support and incentive schemes.
- Private sector and Financial Institutions', for participation, identification, feasibility and financing of various project.
- NGOs and the specialized agencies involved in renewable energy initiatives.

I.2 Objectives of the study

Bangladesh Bank (BB) has developed an incentive scheme for concessional refinancing for small solar energy, bio-gas plants and Effluent Treatment Plants (ETP). These are recent initiatives on their part and Banks are yet to take full advantage of such concessional refinance. This should be knowledge based, efficient and where the small to the large business community, financing institutions, Bangladesh Bank, GoB and Multilateral agencies work towards the common objective of harnessing EE/RE technology. To ensure sustainable development there is a need to start involving the business community, Banks and financial institutions. To understand the processes need to finance EE/RE technology driven products. As these progresses, Bangladesh Bank could also be involved to review their concessional refinancing schemes to encompass more products as well as review existing ones.

Financing is one of the largest barriers to the development of sustainable energy in Bangladesh and this is true for both renewable energy and energy efficiency. This work will consider and evaluate the impact finance and the banking sector has on the development of renewable energy and energy efficiency (Braun and Harry, 1990). In terms of renewable energy projects, both of urban and rural electrification, a large amount of work has been conducted on financing models for the delivery of energy services to both of urban and rural populations. A similar situation exists for energy efficiency in Bangladesh, where the lack of access to finance impedes the uptake and development of more energy efficient methods of industrial production, despite projects being identified where considerable savings in both energy and cash are realizable.

At present Bangladesh takes the different financing models that have been developed and tested for renewable energy projects in urban and rural communities and energy efficiency improvement projects. To explain the research point of view of banking and financing institutions and the risks associated with renewable energy and energy efficiency projects. This research is to prepare a strategy and action plan for removal of barriers to accessing financing for EE/RE technologies, lack of familiarity of commercial banks and such institutions with these technologies, communication gap between financing institutions and potential borrowers of this sector namely, households, businessman and manufacturing industry owners. Many industrial enterprises need financing for improving energy efficiency of existing equipments and/or investment in new technologies. The objective of the empirical research is how could be used renewable energy and energy efficiency technologies to consideration of future generations demand for sustainable energy for development in Bangladesh?

I.3 Methodology

This paper is concerned about the multiple logistic regression analysis, taken primary data on solar energy from Mohakhali and Niketan area, Ward no. 20, Zone-3 (Gulshan) at Dhaka North City Corporation (DNCC) in Bangladesh, on numbers of household 4,062, and 1.729 square km area to the determined influencing factors of access to finance on growth of

renewable energy and energy efficiency. After operating logit regression analysis in software *e-views 5.1* version, obtained result that the economic variables are significant.

I.4 Structure of the study

This paper is organized into five sections- following introduction, literature review including *sustainable* renewable energy, theoretical framework, and demand for renewable electricity in section-ii, analysis of the renewable energy efficiency technologies in Bangladesh in section-iii, section-iv includes data and methodology framework for the analytical analysis and it also identifies and defines the variable considered. Section-v examines and the empirical results explain the existing financing models, including the reasons for their success or failure. In addition, to understand which risks and elements are key for financing institutions when evaluating renewable energy and energy efficiency technologies. Finally, summary finding and concluding remarks of the paper is sustainable energy for development in Bangladesh. To be able to argue which policy or regulatory approach suits best, given the national or regional situation. Refinancing schemes from Bangladesh Bank on a regular basis under the following terms and conditions *table* and survey questionnaire *are shown in appendix.*

II. REVIEW OF THE LITERATURE

II.1 Sustainable Renewable Energy

The expanding of renewable energy across the world is not sufficient (Jefferson, 2006). Market barriers, economic and financial barriers, institutional barriers, and technical barriers prevent penetration of renewable energy into energy markets (Painuly, 2001). The effect of these barriers may vary across technologies and countries. The drivers of development of renewable energy such as Renewable Portfolio Standards (PRS), financial incentives, consumer demand for green power, natural gas price volatility, and wholesale market rules are identified (Bird *et al.*, 2005).

Policies are considered to play important roles in development of renewable energy in various countries (Jacobsson & Lauber, 2006; Winkler, 2005; Tan *et al.*, 2008; Peidong *et al.*, 2009; Mitchell & Connor, 2004). There is controversy about which policy instrument should be adopted. Mitchell *et al.* (2006) argued that a feed-in tariff system is more effective to increase the share of renewable energy because it provides different kinds of risk reduction in terms of price, volume and balancing risk. Böhringer *et al.* (2007) indicate that a tradable green quota is an effective way to reach the European target of "greening" electricity. Menanteau *et al.* (2003) examine concrete examples and conclude that a system of feed-in tariff is more efficient than a bidding system. It is also indicated that the efficiency of green certificates has not been proven due to limited experience.

Effectiveness of various policy measures is examined by empirical studies. Popp *et al.* (2011) indicate that investment in renewable energy capacity across 26 OECD countries owns much to technological innovation, rather than individual policies. Kobos *et al.* (2006) suggest that suggested that if without sustained federal research and development (R&D) and commercial marketplace, it may take a longer time to achieve cost reductions and further market adoption. Marques & Fuinhas (2012) examine several categories of supporting policies in EU countries between 1990 and 2007. Incentives/subsidies (including feed-in tariffs) and policy processes that define strategies and outline specific programs are indicated to be drivers for renewable energy.

Market deployment policies are found to have significant impact on per capita supply of renewable energy (Gan & Smith, 2011), and the effect of other policies (e.g. R&D and market-based policies) are not significant. The effectiveness of Renewable Portfolio Standard (RPS) is found to increase the total amount of renewable energy generation, but it is not a predictor of the share of renewable energy in the total energy mix. Shrimali & Kniefel (2011) investigate the effectiveness of policies on the penetration of various emerging renewable electricity sources. The RPS has a significant impact on the penetration of renewable energy, but this effect depends on the types of renewable sources. Voluntary renewable portfolio standards and green power purchasing programs are found to be ineffective in increasing any type of renewable energy.

Most of the empirical studies have focused on a single policy instrument in one country, or policies of broader categories. An investigation of concrete policy measures may provide more clear implications. Except a study that examines the effect of individual policy measures on technology innovation (Johnstone *et al.*, 2010), other studies examine effectiveness of R&D, feed-in tariffs, and quota obligations all at once. Accordingly, this is what paper I seek to address. It tries to provide some evidence for the theoretical debate on their effectiveness.

II.2 Theoretical Framework

Empirical data supports some voluntary contribution to public goods, such as provision of renewable energy. Economists have extended the standard models to incorporate "impure altruism" (Andreoni, 1990) to explain this. People who contribute are rewarded an additional "warm glow" benefit, which is a motivation for contribution to a public good. Voluntary contributions to a public good can be motivated by perceived social responsibility (Brekke *et al.*, 2003; Nyborg *et al.*, 2006). The decision depends on tradeoffs between the benefit of a "good image" and the cost of contribution. This model implies that economic incentives may have adverse effects on voluntary contributions, e.g. recycling and voluntary community work.

Based on this model, Ek & Söderholm (2008) investigate the determinants of choosing green electricity among Swedish households. Besides the perceived personal responsibility and the perceived consumer effectiveness, the impact of purchasing on the household budget influences willingness to contribute. While economics rely on the concept of preferences and the utility maximization model, psychologists assume that behaviors are predicted by attitudes. A range of studies focused on the role of moral norms and beliefs about environmental conditions and personal responsibility which are based on the norm-activation theory (Schwartz, 1977; Schwartz & Howard, 1981) or the value-belief-norm theory (Stern & Dietz, 1994; Stern *et al.*, 1999).

II.3 Demand for Renewable Electricity

Measuring the economic value of benefits from using renewable electricity could provide information of the location and slope of the demand curve for renewable energy. Many studies from different countries try to estimate a value on the price premium of renewable electricity. The concept of consumers' Willingness to Pay (WTP) is the cornerstone principle in measuring the benefits (Brent, 2007). Although different methods are used, positive WTP values for renewable electricity are usually concluded. Fouquet (1998) cites a survey and indicates that one-fifth of the participants would pay a premium in the UK, and 5% would pay more than a 20% premium. Farhar (1999) uses a market survey of the US to derive a

kind of demand curve. The data suggests that 70% of residential consumers would pay $5 per month, 38% would pay $10 per month, and 21% would pay $15 per month. The derived aggregated WTP curve suggests an exponential fit of the data. Batley *et al.* (2001) indicate that 34% of Leicester population would like to pay and this proportion is higher than the national average of the UK. Over half of consumers in Luxembourg, Netherlands, Sweden and Denmark are willing to pay a premium (Devries, 2004).

Borchers *et al.* (2007) find that in the US solar is preferred over a generic green and wind; biomass and farm methane are the least preferred sources. Hanley & Nevin (1999) evaluate three renewable energy options in remote communities in Scotland. Small-scale hydro and wind farm is more supported than biomass schemes. The mean WTP for small scale hydro across the whole sample is the highest. Although a sizable proportion of consumers state that they are willing to pay more for renewable energy, the real market shows quite different data. Bird *et al.* (2002) review international green power marketing activities by 2002 and the market penetration rates have been typically been in the order of 1%. A successful market example is Netherlands where 13% of residential customers had chosen green power.

Salmela & Varho (2006) discuss the consumer passiveness in the green electricity market in Finland. Both individual and structural factors can influence a green electricity purchase. Lack of knowledge and trust, costs of switching, duties and routines in everyday life, price, and free rider problems could be barriers. The free rider problems in green electricity markets are explored in detail by Wiser & Pickle (1997). Pichert & Katsikopoulos (2008) explain the non-adoption with a kind of status quo bias. If grey electricity is offered as a default, few would switch to green electricity.

Actual adopters of green electricity have been profiled by a few studies. Attitudinal variables are powerful to explain adoption behavior. The effect of income is different according to types of programs (Kotchen & Moore, 2007). The number of environmental associations an individual participates in, economic factors (including WTP), knowledge, and environmental concern are correlated with adoption (Arkesteijn & Oerlemans, 2005). One may argue that people could make simultaneous decisions on membership and adoption in order to aid the understanding of motivations for households to switch to renewable electricity.

III. RENEWABLE ENERGY EFFICIENCY TECHNOLOGIES IN BANGLADESH

III.1 Concentration on Renewable Energy

Bangladesh will achieve considerable success in acceleration of economic growth of course need for sustainable energy for development (SED). Renewable or ‘green’ energy is now at forefront of the country’s priorities for environmentally sustainable economic progress. We urgently need much more energy for our households, manufacturing units and commercial establishments; and we need this energy produced in ways that minimize carbon emission and climate change effects. Although Bangladesh contributes very little to the renewable energy for power generation (more than 2 percent), the government has a vision of enhancing this to 10 percent by 2020. Although our neighbors are doing far better, we too are showing our interests in renewable energy sector, particularly in the solar and bio-gas sub-sectors. Bangladesh Bank is promoting financing for solar energy, biomass and other renewable energy projects with refinance support lines for the lenders. The government is also providing support, including tax/duty waivers for the projects.

Being an agro based economy, the potential and scope for the development of renewable energy and energy efficiency is tremendous in Bangladesh. Additionally from the social perspective, this aligns with existing poverty levels and gender sensitiveness. It has now become essential to rapidly expand the use of technology in diverse products. These are solar home systems, solar lanterns, efficient rice parboiling systems, biogas plants in agro-industries, solar energy powered pumps etc. Likewise, for energy efficiency technologies like improved cooking stoves, concentrating biomass into small pellets or briquettes, converting it to biogas in digesters/gasification, industrial boilers and furnaces, intelligent motor drives, Hybrid Hoffman Kiln etc.

Box-1: Bangladesh Priority on Sustainable Energy for Development

The Bangladesh Government is actively promoting renewable energy and energy efficiency in Bangladesh. The Renewable Energy Policy of Bangladesh, which was drawn up with assistance from GIZ and UNDP and adopted in December 2008, sets a target of satisfying 5% of total power demand from renewable energy by 2015 and 10% by 2020. The new Sustainable and Renewable Energy Development Agency (SREDA) has been approved by the cabinet and will provide investment incentives for renewable energy-related technologies and set appropriate feed-in tariffs for renewable energy and marketing of green energy to ecologically aware customers.

Development needs energy. The reliable and efficient provision of modern energy services is a key to reducing poverty. But Bangladesh is an energy starved country: only 43% of its 160 million people are connected to the electricity grid and, in the rural areas, where over 70% of the population live, only 25% have electricity. A mere 6% of the entire populations have access to natural gas, and they are primarily in urban areas. Most people in the rural areas depend on kerosene lamps for light. 90% of all Bangladeshis cook with biomass, such as rice husks, jute sticks, cow dung, or wood. In fact, 50% of Bangladesh's total energy supply is provided by biomass.

The SED Program is now working with the Ministry of Power, Energy, and Mineral Resources to draw up rules for SREDA, as well as an Energy Conservation Act. The project is also working with the Bangladesh Standards and Testing Institution to set and certify compliance with energy efficiency standards for electrical equipment such as compact fluorescent lamps (CFLs) and light-emitting diode (LED) lamps. However, Bangladesh is already a world leader in one area of renewable energy: The solar home systems program initiated by Infrastructure Development Company Ltd. (IDCOL), a Bangladesh-Government-owned financing company, is one of the world's most successful solar energy programs. It has installed over 1.2 million solar home systems of 20-130Wp in the country's rural villages since 2002, benefitting over six million Bangladeshis. The German Government has been actively supporting IDCOL's solar home systems program for several years now. GIZ, with co-financing from the Dutch-German- Norwegian Partnership Program Energizing Development, provided funds for buy-down grants for over 160,000 such solar home systems, as well as other support for partner organizations to help them develop the market for these systems.
However, the price of a solar home system remains out of reach for many rural Bangladeshis. Therefore, the SED Program, with its private-sector partner organizations, developed still smaller and less expensive solar home systems that even poor households can afford. LED technology was used to design 10-21Wp solar systems that can power two to four lights and charge a mobile phone at a cost of only 10,000 to 15,000 takas (100-150

euros). An even smaller LED solar system, a Pico PV solar lantern with panel sizes of less than 10Wp is able to light a small hut much more comfortably and efficiently than the traditional kerosene lanterns. The aim of the project is to hold the cost of this new solar lantern below the amount that a household could potentially save within two years by replacing its kerosene lamps.

In 2010, SED used solar power to address another crucial problem in southwestern Bangladesh: hurricanes repeatedly sweep over this region and destroy all available sources of clean drinking water. SED used an allocation of 500,000 euros in fast start finance for climate change adaptation from the German Federal Ministry for Economic Cooperation and Development (BMZ) to build 12 solar-powered water pump and purification systems. The systems draw water from surface ponds or underground sources and pump it into water tanks mounted on hurricane-proof overhead concrete platforms, from where a number of pipes lead to various water distribution points in the villages.

III.2 Access to Finance on Renewable Energy

To scale up the use of RE/EE technology and develop this commercially, the need for greater involvement of financial institutions has become essential for rapid growth of RE and EE technologies. Although there have been few channel financing of NGO undertaking of RE projects by banks, but this has had very little impact. The reason for this is the relative absence of a focused approach by banks and other financial institutions to provide commercial loans to RE/EE technology based projects to the small, medium or large enterprises.

To create an environment of the financial sectors' commercial and social involvement for the expansion of RE/EE technology for existing and new customers the following is required to be undertaken to bring about a change: Need to assess the understanding and awareness levels of the commercial banking sector regarding the development potential of EE/RE technologies and the related financing needs in line with policy guidelines for Green Banking and Environmental Risk management of Bangladesh Bank (Central Bank). Identify the barriers to accessing financing for EE/RE technologies and gaps between policy makers, regulators', financial institutions and potential borrowers.

Once the above are ascertained then a strategy and an action plan would be prepared for removal of the identified financing barriers. These findings then would be presented to the relevant government agencies like the MPEMR, Bangladesh Bank and a peer group to be selected from the Government of Bangladesh (GoB), Bangladesh Bank and commercial banking circles.

Renewable energy financing will be needed both at the producers end as large scale project finance and at the users end as loans to households and businesses procuring and installing renewable energy units for own use. The project loans and some of the user loans will be needed for tenors longer than the average tenors of usual fund sources (deposits, borrowings) of the lenders, resulting in asset liability maturity mismatches that can create occasional liquidity difficulties. To get around the mismatch problem, loans in the renewable energy sector can be structured and documented in ways permitting subsequent repackaging and offloading to other investor classes as marketable securities rated by external rating agencies. In the securitization processes, some of the banks and financial institutions will need to assume a market making role, maintaining active liquid market in the securities (World

Bank, 1996). Developing securitization processes in our market will be important in fostering its longer term project financing capabilities, and I feel it is important for training courses on project financing to include adequate content on securitization concepts and modalities; besides tools and techniques of structuring project financing packages. Bangladesh Bank will be happy to do all it can to support securitization in the local market, towards augmenting liquidity for longer term project financing.

Considerable *green energy* for economic growth is important variable, the carbon trading under the Clean Development Mechanism (CDM) which provides a trading window for carbon credits, easing the typically higher cost burdens of renewable energy projects (Martinot and McDoom, 2000). Large emerging market economies like India and China have already benefited handsomely from carbon trading; hastening efforts of Bangladeshi green energy projects for benefiting from this opportunity window brooks no delay. I am sure this course will indeed be a vital resource for project developers who want to learn how to structure bankable renewable energy deals.

Bangladesh Bank through its circulars issued at different times, has offered various refinance schemes, for accommodating special facilities to scheduled banks at concessional rates. The central purpose of these schemes is channeling funds through scheduled banks to specific sectors to accelerate economic activities in those sectors. In order to bolster business activities of the Bank and to reduce our cost of fund, all branches are urged to avail refinancing facilities from Bangladesh Bank on a regular basis under the following terms and conditions, *shown in appendix-1.*

IV. DATA AND METHODOLOGY

IV.1 Sources of Data

To investigate determinants of the share of renewable energy in the energy efficiency is constructed for paper. The contribution of renewable energy supply is used as a relative indicator of development of renewable energy. According to what is suggested by previous literature, economic factors and policy factors are used as explanatory variables. Economic factors include GDP, energy consumption growth, energy import, and energy price. R&D, feed-in tariffs, and quota obligations are popular policy measures and their effectiveness is examined in the analysis.

This research attempts to provide implications for a design of more effective and efficient policies. This research study is based on a number of sources of data – Primary and Secondary. To analysis primary data collected for used cross sectional study to be considered about allied factors for renewable energy especially *solar energy*. Quantitative technique is used in the existence of the causes and effects of influencing factors- access to finance on solar energy and efficiency technology. The survey was conducted in Mohakhali and Niketan area, ward no. 20, Zone-3 (Gulshan) at Dhaka North City Corporation (DNCC) in Bangladesh, on nos. of household 4,062, and 1.729 square km area in Bangladesh. The sampling design that is used in the study is appropriately performed based on the geographical location and also determined the size of sample by using the appropriate formula. Given the sample size and distribution, it is clear that the survey is not intended to provide results representative of the whole household and business centre Mohakhali and Niketan area in Dhaka but to provide a quick diagnostic of renewable energy and energy efficiency technologies determinants in Bangladesh.

The primary data were collected from the respondents during the period of time May, 2014. The survey was conducted over two hundred respondents from a particular area Mohakhali and Niketan at DNCC. The questionnaire is about the standard background of respondents' green energy and energy efficiency characteristics. Respondents were also asked to describe their current residences and membership in environmental organizations. A structured questionnaire was prepared in the light of the objectives of the study that was filled up by direct interview. All filled-up questionnaires were fully scrutinized and the valid data thus collected were processed and analyzed to reach with research objective.

The questionnaire, *appendix-2*, has been designed in light on sustainable energy for development by access to finance on growth of renewable energy (RE) and energy efficiency (EE) technologies for Bangladesh that indicators identified by investigation through primary and secondary data collect and develop the final form along with empowerment variables included in questionnaire. It may be included social factors and economic factors that indicate sustainable energy for development of Bangladesh. Survey shall have been conducted by a group of graduate students and brief training on understanding questions and data collection process will given to the interviewers before starting the work of data collection. A structured questionnaire was prepared in the light of the objectives of the study that will be filled up by direct interview.

To analysis the secondary data are used for an understanding the growth of and per capita renewable energy for socioeconomic growth and development and it's necessary for all attention. Secondary data obtained from various published sources like as, Bangladesh Bureau of Statistics (BBS), Bangladesh Economic Review (BER), Ministry of Power, Government of Bangladesh (GoB) reports (various), Bangladesh Bank (BB), Asian Development Bank (ADB) and World Bank (WB). The questionnaire has been designed in light on renewable energy efficiency and its technology allied factors for strong growth of GDP in Bangladesh and it may be included social and economic factors.

IV.2 Analytical Framework

IV.2.1 Logistic Regression Model

The advanced econometrics models such as multinomial logistic regression model will be used and fit them to identify the inputs significant for sustainable energy for development. The multivariate techniques viz., multiple logistic regression models, will be used to identify the determinants of energy generation in Bangladesh that is accelerating economic growth of a nation. The logistic regression model can be used not only to identify risk factors but also to predict the probability of success. The model expresses a qualitative endogenous variable as a function of several exogenous variables- both qualitative and quantitative (Fox, 1984).

Let Y_i denote the dichotomous endogenous variable for the i^{th} observation.

Where $Y_i = 1$, if RE and EE is full generate,
$= 0$, if RE and EE is under generate.

The linear probability model (LPM) was

$$P_i = E(Y = 1 \mid Xi) = \beta_1 + \beta_2 X_i \qquad (1)$$

Where, X_i is an exogenous variables and β_i's the regression coefficients. The method is to model the response using the logistic function given by

$$P_i = E(Y = 1|Xi) = \frac{1}{1+e^{-(\beta_1+\beta_2 X_i)}} \quad (2)$$

$$P_i = \frac{1}{1+e^{-z_i}} = \frac{e^{z_i}}{1+e^{z_i}} \quad (3)$$

Where $Z_i = \beta_1 + \beta_2 X_i$ and Equation (3) represents what is known as the, cumulative, logistic distribution function (Kramer, 1991). It is easy to verify that as Z_i ranges from $-\alpha$ *to* $+\alpha$, P_i ranges between 0 and 1 and that P_i is nonlinearly related to Z_i (i.e.,X_i), thus satisfying the two requirements. If P_i, the probability of full generate RE and EE, is given by (3) then (1-P_i), the probability of under generate RE and EE is

$$1 - P_i = \frac{1}{1+e^{z_i}} \quad (4)$$

Therefore, we can write

$$\frac{P_i}{1-P_i} = \frac{1+e^{z}}{1+e^{-z_i}} = e^{z} \quad (5)$$

Now $P_i \big/ 1 - P_i$ is simply the odd ratio in favor of full generate RE and EE – the ratio of the probability of full generate RE and EE to the probability of under generate RE and EE. If we take the natural log of (5), we obtain a very interesting result, namely,

$$L_i = In\left(\frac{P_i}{1-P_i}\right) = Z_i$$

$$= \beta_1 + \beta_2 X_i \quad (6)$$

That is, *L*, the log of the odds ratio, is not only linear in *X*, but also linear in parameters. *L* is called the logit, and hence the name logit model.

$$L_i = In\left(\frac{P_i}{1-P_i}\right) = \beta_1 + \beta_2 X_i + u_i$$

(6.1)

To estimate (6.1), the values of the regressand, or logit, L_i. This depends on the type data we have analysis for data at the individual, or micro, level. If we have data on individual families, OLS estimation of (6.1) is infeasible. $P_i = 1$, if generate RE and EE is full and $P_i = 0$, if generate RE and EE is under. These values directly into logit, L_i, we obtain:

$$L_i = In\left(\frac{1}{0}\right) \quad \text{if generate RE and EE is full}$$

$$L_i = In\left(\frac{0}{1}\right) \quad \text{if generate RE and EE is under}$$

Obviously, these expressions are meaningless. Therefore, if we have data at the individual, or micro, level, we cannot estimate (6.1) by the standard OLS routine. In this situation we may have to resort to the maximum likelihood (ML) method to estimate the parameters. Software packages *Eviews - 5.1* have built-in routines to estimate the logit model at the individual level.

IV.2.2 Empirical Methodology

To estimate the model, a widely used multiple logistic regression frameworks are taken to separate out the effects of key inadequate access to finance factors of explanatory variables

impact on generate RE and EE. A consistent time series data on generate RE and EE allied factors are not available for this cases we take cross section data. Regression equations on log of generate RE and EE have been estimated to obtain the effects explanatory variables. The logistic multiple regression analysis has been used. The explanatory variables in the equations consist of the characteristics of the RE and EE and dummy variables for the sector and status of t generate renewable energy. Using the survey data a logistic regression model has been estimated to examine how to generate RE and EE based on various explanatory variables. In the following analysis, we shall estimate equations in the logit form.

Logistic regressions have been presented with the dependent variable as an indicator of the probability of being in generate RE and EE. Dependent variables dummy of RE and EE (= 1, if a generate RE and EE is full, otherwise under) have been included. Using the survey data a logistic regression model has been estimated to examine how to determinants of generate RE and EE based on explanatory variables, shown in below.

Dependent Variable:	
Log of generate RE/EE	= 1, if a generate RE/EE is full, otherwise under
Explanatory variables:	
Year of uses of RE/EE	'1-2 years', '3-5 years', '5-10 years', and 'above'
Stakeholders of RE/EE	'household', 'business', and 'others'
No. Of household members	'<4 members', '4-6 members', '6-8 members', and 'above'
Provider of RE/EE technology	'government', 'NGO', 'IDA' & 'association'
Skills of RE/EE dummy	= 1, if skill on RE/EE, otherwise
Cost of RE/EE technology	= 1, if high up-front costs of RE/EE, otherwise
Amount of loan	'nothing', '< tk. 100,000', 'tk. 100,001 to 300,000', & '> tk. 300,000'
Sources of borrowing	'relative/ neighbour/ friends', 'mahajan', 'ngo' & 'banks'
Rate of interest annually	'< 10%', '10% to 15%', 16% to 20%' & '> 20%'
Collateral for loan	'nothing', 'land and building', 'machinery and equipment', and 'personal assets of owner'
Operational risks on RE/EE dummy	= 1, operational risks and regulatory certainty, otherwise
Market information on RE/EE dummy	= 1, market information is still largely available, otherwise
Insurance on RE/EE technology dummy	= 1, if have any insurance on RE/EE technology, otherwise

The expected sign of explanatory variables coefficients are positive and or negative respectively. The error term is assumed to be random and serially independent having zero mean with finite variance. In order to determine the appropriate technique of estimation, the

empirical model is estimated by logistic regression method. The direction and the strength of between the explanatory variables and log of RE and EE variability are determined from the sign of the coefficient and significance of *t-statistic*. To verify the validity of the model, two major evaluation criteria were used: (i) the a–priori expectation criteria which is based on the signs and magnitudes of the coefficients of the variables under investigation, (ii) Statistical criteria which is based on statistical theory, which in other words is referred to as the Least Square (LS) consisting of McFadden R-squared (R^2_{MCF}), LR statistic (df) and Probability (LR stat).

V. ANALYSIS OF THE EMPIRICAL RESULTS

V.1 Results of Logistic Regression

The empirical analysis is to explore the causes and effects of influencing factors on generate renewable energy and energy efficiency. This analysis begins with an attempt to understand the relationship of allied factors of RE/EE technologies. Now let us interpret the regression results using the data. Since most modern statistical packages have routines to estimate logit models on the basis of ungrouped data. The regression results calculated by *E-views 5.1* are given in table-1.

Table-1: Determinants of Generate RE/EE: Results of Logistic Regression
Method: ML - Binary Logit (total observations: 170)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Constant	23.973	7.708	3.110	0.00
Amount of loan	0.849	0.264	3.212	0.00
Collateral for loan	-2.594	1.001	-2.578	0.01
Cost of RE/EE technology	-3.185	1.027	-3.101	0.00
Insurance on RE/EE technology	1.589	0.679	2.340	0.02
Market information on RE/EE	1.211	0.447	2.709	0.00
No. of household members	-0.782	0.295	-2.651	0.01
Operational risks on RE/EE	-1.565	0.471	-3.318	0.00
Provider of RE/EE technology	1.301	0.268	4.854	0.00
Rate of interest annually	2.403	0.401	5.992	0.00
Skills of RE/EE dummy	0.643	0.258	2.49	0.02
Sources of borrowing	0.818	0.245	3.029	0.00
Stakeholders of RE/EE	0.575	0.211	2.725	0.01
Year of uses of RE/EE	0.371	0.185	2.005	0.05
McFadden R-squared	0.668			
LR statistic (13 df)	93.575			
Probability(LR stat)	0.0000			

Each slope coefficient in this equation is a *partial slope* coefficient and measures the change in the estimated logit for a unit change in the value of the given regressor, holding other regressors constant. The constant coefficient of 23.973 suggesting a relationship between the two variables show statistically highly significant with other variables constant but positive sign means if an individual has no amount of loan, sources of borrowing, collateral for loan, market information RE/EE, provider of RE/EE technology, skills of RE/EE dummy and others. Among the sources of borrowing, collateral for loan, market information RE/EE, and provider of RE/EE technology have expected influences. To capture the effect of cost of RE/EE technology (high =1) does have a significant impact because cost of RE/EE technology is very high.

The coefficient of Stakeholders of RE/EE is positive and highly significant. The positive coefficient reflects the relatively. Thus, the household stakeholder, with other variables held constant, that if household stakeholder increases by a unit, on average the estimated logit increases by about 0.575 units, suggesting a positive relationship between the two and statistically highly significant. Similarly, Year of uses of RE/EE has a positive impact on generate RE in our equation, if a year of uses of RE increases by a unit, on average the estimated logit increases by about 0.371units.

RE/EE technology providers ('government', 'NGO', 'association' and 'IDA') and the coefficient of dummy form (yes=1) "Skills of RE/EE" is positive and significant in the equation. As a consequence, RE/EE technology drives up the returns to physical investment, ceteris paribus RE/EE technology flow, it will imply that the higher the share of RE/EE devoted to investment and therefore the higher the growth rate associated with green energy. Moreover, cost of RE/EE technology also appears as an important complement of RE/EE growth process.

The coefficient of amount of loan is statistically significant in the equations. Similarly the stakeholders may have sufficient scope for borrowing from 'relative/ neighbour/ friends', mahajan, NGOs and banks. Collateral for loan ('land and building', 'machinery and equipment', 'personal assets of owner') is not only obstacles most of the RE/EE stakeholders and also highly significant rate of interest per annum is burden of RE/EE stakeholders' borrower. The coefficient of sources of borrowing and collateral for loan is statistically moderate significant impact on generate of RE/EE.

As we can see regression, respect to all others regressors, results show that full/under generate RE/EE have a higher probability of being under generate of RE than the full RE. Amount of loan has a significant coefficient and thus has advantage over the full generate RE/EE technologies. Low cost RE/EE technologies is better than high cost RE/EE technologies, later has a significant positive impact on the logit, although statistically the effect of rate of interest is significant, but rate of interest is sensitivity to generate log of RE/EE in one hand and other hand coefficient of collateral is negative and significant but coefficient of borrowing is positive and highly significant. This positive coefficient reflects the relatively higher log of generate RE/EE in Bangladesh. Thus, other things remaining same, if high cost RE/EE technologies up to become low cost, each stakeholder will purchase RE/EE technologies.

The coefficient of market information on RE/EE is statistically significant in the equations. Market information on RE/EE is likely to have a positive effect through its positive impact on RE/EE productivity. This effect has been counterbalanced by a negative Operational risks effect on RE/EE productivity. The coefficient of dummy form (yes=1) 'Insurance on RE/EE technology' has positive impact and significant on RE/EE productivity.

However, together all the regressors have a significant impact on the log of RE/EE, as the LR statistic is 93.575, whose *p-value* is about 0.0000, which is statistically significant. A more meaningful interpretation is *in terms of odds*, which are obtained by taking the antilog of the various slope coefficients. Thus we take the antilog of the 'cost of RE/EE technology' coefficients of 3.185 we get $24.16\left(\approx e^{3.185}\right)$. This suggests that low cost of RE/EE technology is used for RE/EE generate more than 24.16 times likely to get a low cost of RE/EE technology, other things remaining the same. Whereas the McFadden R^2 (R^2_{MCF}) value is 0.668, although, this value is overplaying the importance of goodness of fit in models, where

the regressand is dichotomous and full generate RE/EE technologies needs for power will increase substantially.

We are looking at different sources of financing on both RE and EE investment decisions. Overall, financial institutions will aim to create a package that includes the total finance amount and the repayment terms, the interest rate, the repayment schedule and any guarantees or securities.

V.2 Financing Models

V.2.1 Government-led model

Most of the financing programmes are still managed by a government body or donor organization, although the actual model can take on several different forms and include different market players.

V.2.2 Market-based models

Due to the perceived high risk and low return on investment for RE and EE projects, few success stories using a market-based model are available. However, international aid agencies have been developing several market-based business models, especially for rural electrification programmes. To become economically viable with less or ultimately no governmental or donor support, RE and EE projects should strive to get embedded in conventional economic activity, by integrating more private actors in the process, by gradually increasing income through the delivery of energy services and the differentiation of the client base. There is a need for innovative instruments for households with limited cash to overcome the high initial investment costs. These instruments aim to increase affordability for users by spreading the repayment of the capital costs over longer periods and by reducing the initial payment, and to provide a framework for private initiatives to design and offer their services.

V.2.3 Consumer finance

The consumer financing (CF) approach implies consumers purchase their system from a dealer on credit by making a down payment and financing the balance with a loan, making periodic payments of capital and interest. The customer gets (gradual) ownership of the system. The loan plan is generally funded by a separate, small-scale and unregulated financial institution. Successful programmes have kept the down payment at or below 25-30 per cent of the cash cost. By maintaining a high volume of installations, dealers can also reduce the price because fixed costs are spread over a larger number of units. The flexibility of interest rates is limited. Sustainable CF programmes can only reduce rates by seeking affordable financing, controlling operating costs, minimizing loan defaults, and ensuring timely recovery of capital and interest. Finally, adequate after sales service and end-user education are important since they prevent poor system performance and therefore maintain cost recovery and achieve financial stability. The main advantage of this approach is the increased affordability because the end-user can spread out the repayment of the high initial cost.

V.2.4 Leasing

In the leasing model, the leasing company procures systems on a wholesale basis, and then offers them to households through retail lease agreements. In contrast to the CF approach, the leasing company retains ownership of the system, although it is often gradually transferred to the customer. The leasing company usually is a dealer or a related financial or development institution. The payments from the customer cover the equipment costs of the leasing

company minus a slight residual value, interest costs and a return on capital. The key challenges are the achievement of financial stability, since lease lives are typically longer than consumer loan lives.

V.3 Access to Finance

V.3.1 Government finance

In many developed countries, public funding is still the most important source of financing for RE and EE. This funding is usually provided in the form of loans or grants, and is combined with financing from multilateral and bilateral organizations.

V.3.2 Commercial banks

Provided that a proper business plan, acceptable risks and returns on investment can be presented, commercial sources can be interested in financing RE and EE projects through loans and equity investment. Commercial financing organizations apply market conditions in terms of pay-back periods and interest rates, thus making it harder for project developers to secure the financing, but on the other hand this form of financing is still usually more flexible than funds from multi and bilateral organizations.

V.3.3 Microfinance banks

Local communities, both in urban and rural areas, are emerging actors in the financing of clean energy, especially for the low-scale application of RE products and technologies. This trend takes the form of microfinance or community-based "green funds" as mechanisms of consumer financing.

V.3.4 Non Banking Finance

Many nonbanking commercial financiers are usually unwilling to loan to projects with "uncertain" risks, except by applying higher interest rates to cover themselves in what is perceived to be a higher risk situation, or they may demand guarantees from international development financiers. Ultimately the investors and lenders aim for a deal that allocates the risks to the party best able to handle them, that provides ways to measure the project's performance and that gives some monetary safeguards to projects investors and lenders. Loan payments usually must be made on a specific schedule, and if they are late or if the loan is defaulted, the borrowing organization may have an extremely difficult time accessing financing in the future.

V.4 Design Aspects for Sustainable Energy for Development

V.4.1 Clean energy policies

On the institutional side, RE and EE policies and their implementation should be formalized through laws or national programmes approved by the government. Secondly, public RE and EE agencies should be established to implement national policies, the mission being to: Design, implement and evaluate programmes and measure; Contract a range of stakeholders, such as companies, local authorities, or non-governmental agencies (NGOs); Ensure coordination with higher or lower levels of authorities (international, national, regional and local).

V.4.2 Decrease investment costs

The first and principal aim for policies and regulations to enhance private sector financing is to shift some of the investment costs away from the investor (e.g. to the public sector). Indeed, most of the policies and regulations described in the previous section essentially aim

at reducing investment costs for project developers and investors, as do direct subsidies, tax exemptions, feed-in systems, green certificate schemes and the Clean Development Mechanisms, which all provide an additional income for the project and improve the return on investment. The design of a set of policies and regulations to improve the profitability of RE and EE projects is not sufficient to activate the private sector though, and it should be backed by additional measures to reduce the perception of high investment/lending risks.

V.4.3 Increase investor confidence

However promising the support policy and regulations for RE and EE are, the involvement of the private sector will depend highly on the perceived stability and commitment of the government in the medium and long term. Therefore the government should ideally embed long-term targets and incentives in a solid legal framework in such terms, as a guaranteed certain market size and a guaranteed certain price on any quantity delivered. The legally provided guaranteed minimum prices for electricity from RE sources for a period of 10 years, as foreseen in feed-in tariff schemes and some green certificate systems, is an example of additional security for investors.

V.4.4 Decrease investor risk

High risks and lack of guarantees are important barriers for the securing of financing for RE and EE projects. This issue can be addressed by the provision of different types of guarantees from financing institutions and governments, but have to be coupled with the development of new and innovative risk management and risk financing instruments addressing the specific nature of RE and EE investments. The development of these tools is expected to increase insight into RE and EE project's risks, thus decreasing insecurity for private investors and improving the attractiveness of RE and EE projects. Internally, financiers can play their part by evolving from defensive to proactive banking strategies by understanding the business case and the competitive advantage offered by RE and EE funding and by recognizing low carbon-related issues as drivers for developing new products and services, generating additional revenue and increasing market share. Moreover financiers should ideally develop policies and guidelines for integrating environmental dimensions into the investment strategy; e.g. reflecting the cost of environmental risks in the pricing of financial and risk management products.

V.4.5 Decrease transaction costs

As EE and RE projects are often small and distributed across a large number of end-users, the existing procedures in both development and commercial banks involve high transaction costs for these types of projects. A major issue will therefore be to develop strategies and instruments to bring down transaction costs per project. Especially for Clean Development Projects in Africa, it is hoped that the so-called "programmatic CDM" will address the specific issues of small-scale carbon saving projects.

V.4.6 Increase awareness

Last but not least, the policy strategy should always involve an important component of information and capacity-building among key stakeholders, including local bankers and fund managers, but also transmission and distribution system operators, development and electrification agencies, and representatives from the industry.

VI. SUMMARY FINDING AND CONCLUDING REMARKS

Bangladesh contributes very little to the renewable energy for power generation (more than 2 percent), the government has a vision of enhancing this to 10 percent by 2020. This will be a focal point for 'Sustainable Energy' development and promotion which are renewable energy and energy efficiency. Energy efficiency and renewable energy are said to be the twin pillars of any sustainable energy policy. It has a national security benefit as it reduces energy imports (i.e. increase government reserves) and gradually diminishing the rate at which domestic energy resources are depleted.

The Bangladesh Government is actively promoting renewable energy and energy efficiency in Bangladesh. According to Martinot, E. (2001), the Renewable Energy Policy of Bangladesh, which was drawn up with assistance from GIZ and UNDP and adopted in December 2008, sets a target of satisfying 5% of total power demand from renewable energy by 2015 and 10% by 2020. However, Bangladesh is already a world leader in one area of renewable energy: The solar home systems program initiated by Infrastructure Development Company Ltd. (IDCOL), a Bangladesh-Government-owned financing company, is one of the world's most successful solar energy programs. As these progresses, Bangladesh Bank could also be involved to review their concessional refinancing schemes to encompass more products as well as review existing ones.

To analysis primary data collected for used cross sectional study to be considered about allied factors for renewable energy especially *solar energy*. Quantitative technique is used in the existence of the causes and effects of influencing factors- access to finance on solar energy and efficiency technology. The multivariate techniques viz., multiple logistic regression models, will be used to identify the determinants of energy generation in Bangladesh that is accelerating economic growth of a nation. Dependent variables dummy of RE and EE (= 1, if a generate RE and EE is full, otherwise under) have been included. The expected sign of explanatory variables coefficients are positive and or negative respectively. The coefficient of amount of loan is statistically significant in the equations. Similarly the stakeholders may have sufficient scope for borrowing from 'relative/ neighbour/ friends', mahajan, NGOs and banks. Collateral for loan ('land and building', 'machinery and equipment', 'personal assets of owner') is not only obstacles most of the RE/EE stakeholders and also highly significant rate of interest per annum is burden of RE/EE stakeholders' borrower. The coefficient of sources of borrowing and collateral for loan is statistically moderate significant impact on generate of RE/EE. Thus, other things remaining same, if high cost RE/EE technologies up to become low cost, each stakeholder will purchase RE/EE technologies. However, together all the regressors have a significant impact on the log of RE/EE, as the LR statistic is 93.575, whose *p-value* is about 0.0000, which is statistically significant.

The reasons behind the relatively limited financing for renewable energy in Bangladesh, thus far are multiple, market information is still largely unavailable, operational risks and regulatory uncertainty, high up-front costs of RE/EE technologies, inadequate access to finance for research and development, and perception of high investment risks by financiers. A strategy aiming to attract more private sector funding should provide the following incentives:

- Lower investment costs for investors and project developers: instruments include subsidies, tax measures, feed-in or quota schemes and a use of the Clean Development Mechanism.
- Fewer risks for investors: governments and development organizations can provide guarantees, while private investors should get familiar with the specific nature of RE and EE projects in order to better assess, control and price the risks and returns.
- More investor confidence by adopting legal frameworks setting long-term targets and incentives.
- More awareness: there is a clear need for capacity-building among a range of stakeholders, including local bankers, industries, transmission system operators, electrification agencies and NGOs.
- Lower transaction costs by developing new and innovative tools to address the often small-scale nature of RE and EE projects. The first initiatives have appeared recently, introduced usually by regional development banks.

When successful, these new approaches could be capable of triggering the involvement of commercial banks. Point of view of banking and financing institutions and risks associated with renewable energy (RE) and energy efficiency (EE) technologies. In recent years new financing models have been developed based on local capacity and higher involvement of consumers. The best known are micro credit consumer programmes for small-scale RE systems, and seed capital provision for small and mid-size enterprises (SMEs) to assist local entrepreneurs in starting up new businesses in clean energy products and services. The rationale behind these deal structures is to prepare young enterprises for later growth capital from more commercial sources. It can be expected that in the near future these emerging and still perceived high risky sectors will continue to rely at least partly on non-commercial investment. Eventually though, RE and EE project development will have to be induced by market-based incentives, allowing them to attract conventional sources of finance. One may argue that people could make simultaneous decisions on membership and adoption in order to aid the understanding of motivations for households to switch to renewable electricity.

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APPENDIX

A-1: Refinancing Scheme from Bangladesh Bank on Solar Energy, Biogas & Effluent Treatment Plant (ETP) under the following terms and conditions:

Letter No., Circular No, & Date	**A. Solar Energy**	**Description for Urban Area**	**Description for Rural Area**
➢ ACSPD Circular No: 06; October o3, 2009 ➢ ACD Letter No: 01 June 20,2010, and ACD Circular No: 09 April 08,2010 (Please follow ACSPD Circular No: 06 October o3,2009) ➢ SDP Circular No: 02 September11,2011 (Please follow ACSPD Circular No: 06 Octobero3,2009)	Solar Panel Capacity	170 watt (min.) & 520 watt (max.)	Residential: 10 watt (min.) & 130 watt (max.) Commercial: 520 watt (max.)
	Maximum Loan	BDT. 60,000/- (min.) & BDT. 1, 75,000/- (max.)	Residential: BDT. 10,000/- (min.) and 70,000/- (max.) Commercial: BDT. 1, 75,000/- (max.)
	Eligibility for loan approval	Individual/ collective households/ business institutions	Individual/ collective households/ business institutions
	Debt- Equity Ratio	Upon Bank- Customer relationship	Upon Bank- Customer relationship
	Interest rate at customer's end	Direct: current bank rate 5% + Maximum 4%	Direct: current bank rate 5% + Maximum 4%
		Credit wholesaling through NGO linkage: current bank rate 5% + Maximum 5%	Credit wholesaling through NGO linkage: current bank rate 5% + Maximum 5%
	Loan repayment duration for customer and interest calculation	Principal and interest payment by 3 years; quarterly interest payment	principal and interest payment by 3 years; quarterly interest payment
	Loan repayment duration under refinancing scheme	Principal and interest payment by 3 years; quarterly interest payment	principal and interest payment by 3 years; quarterly interest payment
	B. Bio gas Plant	**Establishment of plant within the existing farms**	**Integrated plant and cattle farm**
	Bio digester	Production: 1.2 m^3 (min.) & 4.8 m^3 (max.)	Production: 4 Cows (min.) & 4.8 m^3 (max.)
	Maximum Loan	BDT. 18,000/- (min) & BDT. 36,000/- (max.)	BDT. 3, 00,000/-(lacs) (max.)
	Eligibility for loan approval	Individual/ collective households/ business institutions	Individual/collective households/ business institutions
	Debt- Equity Ratio	Upon Bank- Customer relationship	Upon Bank- Customer relationship
	Interest rate at customer's end	Direct: current bank rate 5% + Maximum 4%	Direct: current bank rate 5% + Maximum 4%
		Credit wholesaling through NGO linkage: current bank rate 5% + Maximum 5%	if there is an agent/ intermediary working for bank then, current bank rate 5% + Maximum 5%
	Loan repayment duration for customer and interest calculation	Principal and interest payment by 3 years; quarterly interest payment	Principal and interest payment by 3 years; quarterly interest payment
	Loan repayment duration under refinancing scheme	Principal and interest payment by 3 years; quarterly interest payment	Principal and interest payment by 3 years; quarterly interest payment

Source: BRPD (Banking Regulation and Policy Department) Circular, Bangladesh Bank

A.2: Survey Questionnaire

RENEWABLE ENERGIES (RE) WITH RELATION TO ACCESS TO FINANCE

To be filled in an interview (if applicable) with stakeholders like: 1. Mode of Household or Business (Rice mill, Poultry farm, Dairy Firm, Manufacturer industries, others) 2. Contractors/Suppliers/Service providers 3. Bankers 4. Associations 5. Bangladesh Bank

Name of Interviewer:	
Name of Household/Firm:	
Age:	Sex:
Telephone-Office:	Factory:
E-mail:	Web-page:
Address:	

1. In which year was the firm setup? _____ Year. How many years were establishment of this firm? _____ Years

2. For how many years have you been working in this firm as a manager or owner?____ Years

3. Do you know what renewable energy is? _____ Yes=1 or No=2. If yes, generally where did you hear of renewable energy? *(please tick)*
a. TV b. Newspapers c. Radio d. Energy Advice Centers e. Internet f. Word of mouth
g. Other, please specify: _____

4. Do you know of anyone personally (i.e. friends, relatives or colleagues) who have used renewable energy? _____ Yes=1 or No=2 or doesn't know= -666

5. Which types of renewable energy are you familiar with? *(please tick)*
a. Biomass (wood, straw, etc) b. Biogas c. Solar d. Hydroelectric e. Wind

6. Should the GoB provide affordable heat and power from sustainable energy (renewable) sources? _____ Yes=1 or No=2. If yes, Should the GoB create an energy efficiency grant scheme to help people in the community to become energy efficiency? _____ Yes=1 or No=2.

7. Are you environmentally conscious and familiar with renewable energy technologies and their benefits? _____ Yes=1 or No=2

8. Would you have implemented in your own home or business biogas plant? _____ Yes=1 or No=2. If yes, which since _____ year. What percentage of your electricity comes from your own biogas plant? _____ % total power.

9. Are you aware of government grants to help you to invest in renewable energy such as solar panels, biogas, and ETP plant? _____ Yes=1 or No=2 or doesn't know= -666

FINANCE SCHEME

10. Which of the following best describes your main line of business? Please select one of the options below: (*Please tick)*

a. Rice mill
b. Poultry farm
c. Manufacture of dairy products
d. Manufacture of bakery products
e. Manufacture of vegetables and animals oils
f. Manufacture of prepared animal feeds
g. Grain mill products
h. Sugar factories or refineries or confectionery
i. Other processing (please specify _____)

11. Information of Present Commercial Bank:
Name of Bank and Branch: _____

12. If you currently do not have a loan, what reasons? _____
12.1. Because I did not apply for a loan. If your establishment did not apply for a loan, what was the principal reason? (*Please tick)*

I. Do not need loan
II. Application procedures for bank loans are too complex and time consuming
III. Collateral requirements of bank loans are too strict
IV. Interest are too high
V. It is necessary to have contacts or give informal payments to get the loans. There is corruption in the allocation of bank credit
VI. Did not think that the loan application would be approved
VII. Others (specify: _____)

12.2. Because your last application for a loan turned down. If your loan application was rejected, what was the principal reason given to you by the bank for that? (*Please tick)*

I. Lack of accepted collateral (e.g. your property cannot be accepted as collateral)
II. Application was incomplete
III. The project was perceived as having lack of profitability
IV. Bad credit history
V. Others (specify: _____)

12.3. Because the approval of your application for a loan is still pending ___Yes=1 or No=2

13. Does your establishment have:

a. Checking or saving account? _____ Yes=1 or No=2
b. Property and accident insurance on its asset? _____ Yes=1 or No=2
c. Annual financial statement checked and certified by an external auditor? ___ Yes=1 or No=2
d. Majority of own or lease (rent) land? _____ Yes=1 or No=2
e. Majority of own or lease (rent) building? _____ Yes=1 or No=2

14. Access to finance (e.g. collateral required) is a problem/ obstacles for establish of renewable energy _____ Yes=1 or No=2. If yes, Please identify the contribution each of

the following sources of financing for your establishments. Select the options below: (*Please tick)*

I. Internal funds or retained earnings
II. Domestic commercial banks (loan, overdraft)
III. International commercial banks
IV. Leasing arrangement
V. Government agencies
VI. International development agencies
VII. Private investment funds
VIII. Trade credit
IX. Equity, Sale of stock
X. Family and Friends
XI. Informal sources (e.g. money lenders)
XII. Others (specify: _____)

15. Does your establishment have an overdraft facility or a line of credit? For this question, please consider short term credit but do not consider loans. _____ Yes=1 or No=2. If yes, what was the average annually interest rate on your overdraft or a line of credit? Cost of financing (e.g. interest rates) _____ annually

16. Does your establishment currently have a loan from a financial institution? _____ Yes=1 or No=2. If yes, for the most recent loan _____ '000 taka.

17. What year was your loan approved? _____Year. What is the total duration of the loan (from the moment you received the money until the moment it must be fully repaid)? _____ years

18. Did the loan require collateral or a deposit? _____ Yes=1 or No=2. If yes, which of the following were used as collateral? (*Please tick)*

a. Land and building
b. Machinery and equipment (including vehicles)
c. Tangible assets (e.g. inventory)
d. Personal assets of owner (e.g. house)
e. Other (specify:_____)

19. What was the value of the collateral required as a percentage of the loan value? _____ % of loan value. What was the loan's approximate annual rate of interest? _____ % annually

20. Experience with Bank. (*Please tick)*

a. Offer for Loan but not Gotten
b. Demand Mortgage
c. Unexpected demand

21. Expectations to Bank

_____

BANKERS

22. Would you seems to be Bangladesh Bank popularize re-finance scheme for renewable energy? _____ Yes=1 or No=2. If yes or no, Why? _____

23. Bangladesh Bank re-finance scheme for renewable energy gets poor response. Why? Select you major obstacles below: (*Please tick)*

a. High cost of its items
b. Lack of awareness
c. Security problems
d. Others (Specify: _____)

24. Are you aware of government grants to invest in renewable energy such as solar panels, biogas, and ETP plant? _____ Yes=1 or No=2 or doesn't know= -666

25. Does your bank give collateral free loan among the poor people for renewable energy? _____ Yes=1 or No=2.

26. Do you think that Commercial bank should increase loan for every type of renewable energy technology? _____ Yes=1 or No=2 or doesn't know= -666

ASSOCIATIONS

27. Are you a member of association (e.g. Grameen Shakti) _____ Yes=1 or No=2. If yes, how much do you pay annually in subscription fees to your association? _____Taka

28. Did you offer training to your skill develop on biogas plant from association? _____ Yes=1 or No=2.

29. What percentage of your renewable energy machines is computer controlled? _____ %

30. Does your establishment have any staff exclusively dedicated to innovation and research and development (e.g. Knowledge development)? _____ Yes=1 or No=2

31. What percentage (of the value) of your establishment's machinery and equipment is imported? _____ % of machinery and equipment imported.

32. Has your establishment received an internationally-recognized quality certification (e.g. ISO 9000, 9002,…, etc)? _____ Yes=1 or No=2 or application is process. If yes, please specify which quality certification(s): _____

33. If you give your valuable opinion about renewable energy :

THANK YOU VERY MUCH FOR YOUR COOPERTION IN ANSWERING THIS QUESTIONNAIRE

Courtesy: GiZ, Solar power has also been used to set up hurricane-proof water pumps and purification systems in southwestern Bangladesh