

## **Renewable Energy Empowerment at the Grassroots: The Success Story of Solar Home System (SHS) in Bangladesh**

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### **Abstract**

*One of the densest country in the world in terms of population, Bangladesh have long been struggling to ensure access to power for its burgeoning 18 million population, which has subsequently impacted its developmental journey. However, in recent decades, the country has significantly recovered its power generation deficit through innovative measures that strategically target the poorer segments of the population. The Solar Home System (SHS) has been a shining exemplar of this success, with Bangladesh today boasting the largest off-grid renewable energy network in the world. Since its inception in 2003, 5.5 million SHS has been installed throughout the country, creating 75,000 jobs, and saving Us \$411 million worth of fuel. The proliferation of SHS has been led by Infrastructure Development Company Limited (IDCOL), which used prudent strategies involving micro-credit financing, strict quality monitoring, marketing, awareness campaigns, in order to ensure success of the project.*

### **Bangladesh Power Sector Overview**

As global awareness on the negative impact of fossil fuels continue to gather momentum and cost of renewable sources of energy fall in tandem, economies all around the world are diverting resources to renewable energy development. The use of renewable energy has consequently risen considerably all around the world. More than a hundred countries have already developed national renewable energy policies of one kind or the other; Bangladesh being one of them. (Barua 2017).

The power sector of Bangladesh has seen a considerable growth over the last decade. According to official figures, the country has overseen a rise in the demand for energy by an average of 10 per cent annually during this period (World Bank 2020). The total power generation capacity currently stands at above 22,000 MW. The goal is to increase the capacity to 40,000 MW by 2040 (MPEMR 2016). While the growth in capacity and demand has been praiseworthy, production has been limited by issues related to distribution, inefficiencies due to old equipment, and poor transmission & distribution networks. Around 97% of the countries' population is currently under electricity coverage (on-grid and off-grid) with many in the 'haors' and island regions of the country still lacking access (Dhaka Tribune 2020).

One of the key components of the current government's plans for the rapid expansion of access to electricity has been to utilize Bangladesh's renewable energy capacity. At present, renewable energy consists 3% of the total power generation of the country (Barua 2017). The country is blessed with year-round sunshine providing it with a huge potential for solar energy development. Out of the current 650 MW of electricity that is produced through renewable sources, 415 MW is sourced from solar power (SREDA 2020).

## **The Proliferation of Solar Home Systems (SHS)**

Despite being on the Least Developed Countries (LDC), Bangladesh has harnessed the potential of solar power, which is widely known to be an expensive renewable energy source hence limiting LDC's ability to sustainably invest in them. One of the key factors behind the rapid growth of the solar energy sector in the country has been the utilization and installation of Solar Home Systems (SHS) in the off-grid areas. Almost 5.5 million systems have been installed so far with an average of 60,000 installations per month (BSS 2018). These small-scale solar home systems now provide electricity to more than 4 million households and about 20 million people in rural areas (roughly one-eighth of the country's population), most of whom are not connected to the country's grid (Hutt 2020).

The SHS program was launched by Infrastructure Development Company Limited (IDCOL) in January 2003, with a target of ensuring access to clean electricity for the off-grid rural areas of Bangladesh. Initially, the program started out as part of the Rural Electrification and Renewable Energy Development Project (RERDP) with support from the International Development Association (IDA) of The World Bank Group and Global Environment Facility (GEF). The target was to install 50,000 SHS in off-grid areas within five and a half years, which was achieved by August 2005, three years ahead of the completion date. (Meyer 2015) In addition, the whole project was completed at an estimated \$2 million below the budgeted cost (Schaefer 2017). This paved way for further investments from the investors and other donor firms.

The SHS program has so far saved consumption of 1.4 million tons of kerosene worth US \$411 million approximately, while creating 75,000 employment opportunities across the country (IDCOL 2019). The program is considered to be the largest off-grid renewable energy in the world. The project's objective has been to improve the basic service delivery of power and energy, particularly for the rural areas and the low-income households of Bangladesh. The objective fell in place with Bangladesh's overall targets regarding the United Nations Millennium Development Goals (MDGs), as well as the government's target to increase the share of renewable energy to 10% of the total power generation by 2020. (Reuters 2011)

### **The SHS Structure**

The basic mechanism of IDCOL's SHS program involves IDCOL providing grants and loans to a carefully curated list of Partner Organizations (POs). These partner organizations then pass on these loans to the end users in the form of micro credit schemes to procure and install the SHS, and provide after-sales service. The entire process involves the actions of multiple actors and stakeholders. IDCOL sources the funds from governments and various development partners who provide these funds to IDCOL for disbursement through IDCOL's for-profit financial schemes. In addition, the government provides various other forms of support as well, including incentives through tax waivers, duty-free benefits etc. On the other hand, the donor agencies support the provision of their funds through technical assistance in the implementation of the SHS program.

IDCOL disburses these funds as soft loans to various partner organizations (PO) that are spread out all over the countries. These loans also have grants applied to them to reduce the cost of the solar panels for the end consumers in rural areas. In addition, IDCOL also provides technical assistance and capacity building support to these partner organizations in the form of training, logistic and promotional support.

To ensure quality of implementation and service delivery, IDCOL maintains a strong monitoring network. The monitoring phase can be divided into two segments. Firstly, a PO selection

committee carefully curates the list of POs that are eligible to provide service in each area. This selection committee includes representatives from IDCOL and relevant government ministry & affiliate organizations. The POs are primarily selected on the basis of their micro-finance experience and financial strength. Secondly, a technical standards committee determines the technical standards for the SHS, reviews product credentials of dealers, and approves the eligible equipment. This committee includes technical subject matter experts from top universities, engineering departments in government and IDCOL.

## **Key Success Factors of SHS**

### **1. Quality Monitoring:**

The program adopted a Quality Assessment framework that linked the testing for the components and the provision of funds with regular field inspections of a significant share of the installed equipment. These measures were buttressed by stringent warranty requirements that were strongly enforced. These component testing measures and the strong financial requirements ensured that the SHS met the minimum basic criteria for quality and system design. IDCOL has made it an essential requirement to inspect and verify the quality of 50% of the installed systems before providing grants to the POs (Lighting Global 2015).

Between 2007 and 2012, IDCOL carried out monitoring and quality assurance on its own. It utilized KfW for a technical of the SHS and financial review of the POs, in 3 phases where 11,371 systems (1.5% of all) were tested. (Meyer 2015). In addition, a mantra of 'Quality control from all dimensions' focused upon which subsequently enabled the program have lower purchase and operational costs in the long run. IDCOL's approach in this regard combined its standards for inspection and monitoring. IDCOL forms PO Selection Committee and the Technical Standards Committee (TSC) which includes inspectors from all stakeholders including government sections such as the SREDA. The field inspections ensures that the vendors are aware that their systems maybe inspected anytime, thereby forcing them to provide the best quality equipment. This approach was necessary in the Bangladesh market, given IDCOL's nascent position in the sector and the limited geographic extent of the market. As of November 2014, there were over 150 quality inspectors that performed these activities from 12 regional offices (Lighting Global 2015).

Additionally, a range of minimum warranties are also required for each component. For example:

- At least 20 years warranty is mandatory for the panel, 5 years warranty for the battery and 3 years for charge controllers and LED lights.
- POs are also required to establish post warranty support structures and contribute to achieving and maintaining a high level of quality of the installations.
- Informing and educating the users were also necessary in order to prevent improper handling of the SHS such as bypassing charge controllers, which leads to battery damages (Meyer 2015).

Out of the total 56 POs across the country, multiple POs are present in each area. This removes the opportunity to create monopoly and fosters competition, which consequently lowers costs of the equipment and improves quality of service.

### **2. Financial Framework:**

The government has a national vision of universal access to electricity by 2021. While the costs of the components of the SHS program has been coming down owing to the falling global price

of solar panels, they are still dauntingly high for rural households in Bangladesh. To solve this issue, IDCOL uses the framework of the micro-credit scheme pioneered by Grameen Bank, to make SHS more affordable for the rural households.

The SHS program is funded through long term zero interest loans from the World Bank and other international donors to IDCOL. Later IDCOL provides loans to the POs at a shorter term. This results in final loans being payed to the households with an interest rate of 8-15% over one to five years (Bhandari 2014). The repayment terms are designed in a manner that the monthly installment payments are equivalent to the monthly kerosene expenses – which were the alternative fuel source in the absence of the solar panels. Because of the generous loan repayment schemes, 88% of the customers were able to pay back despite being very poor. The SHS program proves that how an efficient microfinancing model can alleviate poverty and increase the possibility of green growth.

In 2003, the market was small and the risks were higher, so, IDCOL had to charge a strict financing policy with 50% initial payment and the rest being paid within 6 months. As the project was able to source components locally at a lower cost, while the subsidies on grid electricity continued to reduce, the loan terms became more generous with time. Today, IDCOL is providing loans to the customers with 15% down payment and the rest being paid within 5 to 7 years.

In addition, grassroots local POs provided technical support and financing options as well. This helped the local population install SHS and maintain it themselves. Local partner organizations provided maintenance training to the consumers during the loan-repayment period, and various packages were also offered that were crafted according to the needs of the different income groups in the rural areas. To that end, as a result of the system, the poorest could also own a SHS, paying as little as 10 percent down payment and the rest through 36 monthly installments. (Haq 2011).

### 3. Business Case Support:

The program has achieved rapidly growing penetration rates through the business scheme structured to generate profit for the investors. POs report an average loan collection rate of 96 percent and are servicing their debt to IDCOL. The SHS program uses grants and subsidies from government and multilateral donors to make the system less expensive compared to diesel generators, which makes it financially sustainable. The widespread adoption and success of the business model has enabled the government to gradually phase down subsidies from \$90 in 2003 to less than \$20 now (Meyer 2015). This has made the system financially practical for all the investors.

### 4. Strategic Market Penetration:

The provision of low-cost electricity at subsidized prices has played a critical role in growth and development of the Bangladesh economy. Hence, the SHS program focuses on the off-grid areas of the country to avoid any sort of duplication of subsidy schemes. Bangladesh is currently generating around 650 MW of electricity from renewable sources, which is just ~3% of total installed capacity. Off-grid Solar Home System captured a significant portion, producing around 328 MW of the total 416 MW of solar power (SREDA 2020). IDCOL subsidizes the solar panels and provides families with grants and credits to provide part of the cost. As the subsidy is fixed for all SHS sizes, the poorer segment of the society is able to avail larger percentage of subsidy for the smaller systems.

For many people in rural Bangladesh, the installation of solar panels can be a reliable and financially viable solution. A 20 watt-peak system costs about US\$150, which is paid by the users over three years (CHANG 2015). In recent times, local grid-based electricity supply has received global attention and studies by the International Energy Agency (IEA) and World Bank suggest that such mini-grids could cater for 60% of electrification demand in the future (Alam and Bhattacharyya 2016)

The raw materials and equipment that are used to manufacture the solar panels are sourced within the country. This has helped to lower the production costs and generate employment opportunities for the domestic industries. Even though all the main components of SHS are manufactured locally, there are assemblers that assemble the system while importing most of the components from China. Regardless, each SHS and its constituents must meet the standards set by IDCOL to ensure quality control. POs are either vertically integrated in the manufacturing process or assemble their own SHS or they purchase them from dedicated manufacturers and assemblers (Kabir 2015). Initially, batteries were the only component produced in Bangladesh. However, to promote local sourcing, IDCOL has been providing loans at concessional rates to the local manufacturers of PVs. Today, all components (including solar panels on a limited scale) are produced locally. Such promotion of local sourcing has enabled Bangladesh to create new jobs in the renewable sector. Currently, Bangladesh ranks fifth in terms of the largest renewable energy workforce employing 137,000 people (The Financial Express 2020) .

#### 5. Marketing & Convenience

Initially, the SHS program was met with skepticism from the mass rural people. However, they gradually started to cozy up to the idea as the project proved its merit. The key to making the Bangladeshi rural people engaged was the grassroots engagement with the local organizations. With the help of the Partner Organizations (POs) and IDCOL's emphasis on quality and after-sale maintenance, it was possible to gain trust of the people (Yee 2016). SHS is a potential source to meet the unmatched demand of energy due to the geographic location of the country. Being a disaster-prone country, the electrification of coastal areas with SHS are lower than those of conventional grid expansion. There is a risk of the solar panel getting damaged very often due to natural hazards. To circumvent the situation, IDCOL introduced solar panels that are detachable and can be brought indoors anytime. As a result, almost 70% of the local population were able to avail electricity without the risks of damage (Khan, Hassan and Amin 2018). Additionally, a disaster management fund has also been created to help the cyclone affected customers (Bangladesh Disaster Risk and Climate Resilience Program 2018).

#### **Overcoming the Challenges**

In 2014, the Bangladesh government took an initiative to spread SHS at free of cost among the poorest population. This enabled many inefficient and inexperienced partner organizations (PO) to emerge and distribute poor quality products at lower prices among the consumers. Though the issue has been addressed by the government by involving IDCOL in the distribution process, many inefficient SHS providers are still active. Currently, IDCOL is working in collaboration with SREDA to adopt a national standard for solar equipment to prevent pervasive expansion of poor-quality products in the unregulated market outside IDCOL's program (Meyer 2015).

Bangladesh has also been working relentlessly to expand its energy generation capacity and achieve the target of electricity for all by 2021. It is expected that upon the completion of Dhaka and Western Zone Transmission Grid Expansion Project the number of annual power outage will be reduced to 15 from 60 and add 7,440 megavolt-amperes of power transmission capacity

(bdnews24.com 2020). With this expansion, grid electricity will become cheaper and SHS will become less lucrative slowly in terms of pricing and convenience. In the context of a dwindling market of SHS, a large number of POs have failed to repay their loans to IDCOL. As a result, in 2018, IDCOL's total due stood to 2000 crores (Hossain 2018).

Furthermore, the power generation roadmap of the government lacks specific details that identifies the potential dates when certain off-grid areas may receive electricity. Without such specifications in the roadmap, IDCOL and POs are unable to assess risks effectively and set interest rates accordingly. As a result, POs are not being able to provide PVs to certain off-grid areas without assuming the risk of suffering a huge loss. Besides, the SHS project is a subsidizing profit generating scheme. Being a developing country there has always been a segment of the population that has been extremely poor and unable to pay for the solar panels, even with the cheapest option. This makes 100% penetration for the program very difficult.

Environmental management has been another key concern as the disposal of used lead batteries is an ongoing challenge for IDCOL. A significant fraction of used batteries was initially being dismantled and refined under uncontrolled conditions in the informal recycling sector (PWC 2017). Under IDCOL's SHS program the manufacturers are required to provide five years of battery warranty with a capacity of 30 Wp and above, and three years for the smaller batteries. The POs are responsible for the collection of the expired batteries and recycling them. However, out of the 14 enlisted battery suppliers from the program, only 4 had their own recycling plants, while 4 others entered into arrangements of using the plants (IDCOL 2017). However, the program's rapid growth means that all the suppliers will have to eventually build their own recycling plants. The solar panels have a typical shelf life of 20 years. They will be reaching the end of their useful lives in the next decade as most of the solar panels have been installed after 2008 (IDCOL 2017).

## **Moving Ahead**

Bangladesh currently has over 5.5 million SHS installed, most in remote off-grid areas where electrification through grid expansion is challenging and costly. Thus far, the program has ensured supply of solar powered electricity to 18 million people which is 12% of the country's total population. IDCOL alone has a target to finance 6 million SHS by 2021 (IDCOL 2019). IDCOL's SHS program is considered to be one of the most successful programs of its kind in the world. IDCOL has collaborated with multilateral development partners including ADB, to conduct capacity building exercises. Till date, 150+ professionals from over 10 delegation teams around the world have attended IDCOL's Experience Sharing Program (IDCOL n.d.).

Despite having excess capacity, many on-grid rural areas in Bangladesh suffer from frequent load shedding, during which the IPS or generators become an alternative source of power. However, these devices consume a lot of energy and are known to be harmful for the environment. In that regard, SHS can be used as cheaper and greener option to supplant this electricity requirement during load shedding periods. In addition, to achieve 100% penetration with the SHS program, incorporation of latest technology and investment in domestic investments that manufactures solar PVs is highly required. This will bring down the cost and make the program more affordable for poorer segments while generating profit.

As grid electricity is cheaper and is expanding all over the country, consumers will prefer it over SHS. Hence, attention needs to be focused towards renewable energy that is connected to grids. For example, solar irrigation pumps have enabled farmers to improve crop yields as most farmers in Bangladesh today rely on solar irrigation pumps, that are cleaner and cheaper than the diesel-

powered ones (Hutt 2020). There are many other possible options like bio-mass, bio-gas, solar parks, wind etc. to be connected to grid for a sustainable green development.

According to the Bangladesh Power Sector roadmap, by 2030 the country will rely on imported energy for 90% of its generated power. The generation capacity requirement by 2030 is 39,000 MW and probable power generation using renewable energy resources is 2,700 MW (BPDB 2011). The government will face several challenges including the exceptionally high cost of imported LNG, oil and gas. As such, the government will have to rely on subsidies, availability of foreign currencies while setting electricity tariffs. For this reason, cleaner alternatives such as solar and wind need to be focused on.

Bangladesh's entrance into solar power usage has been a successful story all over the world. Within a short span of time, with IDCOL and many POs, the government has been able to ensure access to electricity for a large segment of the disconnected rural population through the SHS program. The market for SHS and solar powered possibilities in general is limitless. In addition to the 15 million rural households who have already been benefitted by SHS, an estimated 45 million city dwellers have the opportunity to harness solar power and contribute to the national grid in exchange for government subsidies, similar to the UK's Clean Energy Cash Back Scheme. Environmentally, the solar power technology has zero carbon footprint. And economically, a population of 180 million offers enormous demand for solar modules because of their price point, efficiency, and ability to mitigate poverty by enabling a business eco system in the rural areas ensuring electricity in every household (Kabir 2015). The SHS Model is easily replicable in African and Asian countries that still lacks the access to electricity. Bangladesh is the example of that.

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