

Current Scenario of Solar Home Systems and Future Utilization in Bangladesh

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Abstract

As a country of acute power crisis, Bangladesh is now looking forward to developing its renewable energy sources. In this work, we survey the current art of the solar energy technologies being used presently and future utilization in Bangladesh. This paper emphasizes that a reliable, affordable, and secure supply of energy is important for socio-economic development. Solar energy may help a lot in achieving sufficiency in electricity especially in rural areas. It is known from different sources that only 75% population have access to electricity in Bangladesh and nearly 75% of the population is rural and only about 30% of the rural households have access to grid electricity. The rural areas are not often feasible for conventional grid-based electrification due to high investment and running costs. The Infrastructure Development Company Ltd recently states that the number of solar home systems (SHSs) in Bangladesh (April 2016) is 3.9 million. As a result, more than 25 million people are benefitted from solar electricity.

Keywords

SHS, IDCOL, Demand-Supply Gap, Electricity Generation Status.

1. Introduction

Electricity is the most important resource for the foundation of economic growth of a country and constitutes one of the vital infrastructural inputs in socio-economic development. The world faces a surge in demand for electricity that is driven by such powerful forces as population growth, extensive urbanization, industrialization, and the rise in the standard of living. In 1901, a private generator was erected in the house of the then Nawab of Dhaka, marking the beginning of the widespread use of electricity in the area. On December 7, 1901, Mr. Bolton, a British national, flipped the switch that began supplying Ahsan Monjil with electricity. In the 1930s, DEVCO, a subsidiary of Octavian Steel Company, initiated a privately owned electricity distribution system by establishing the Dhanmondi power plant for commercial electricity distribution.

In 1972, Bangladesh Power Development Board (BPDB) was created to boost the power sector. A different approach and a new model were considered for undertaking a comprehensive scheme. Thus, the Government created Rural Electrification Board (REB) in October 1977. Later in 1991 Dhaka Electric Supply Authority (DESA) was created basically to operate and develop distribution system in and around Dhaka (Halder et al., 2015). Bangladesh populates more than 160 million people in a land mass of 147,570 sq km. In 1971, just 3% of Bangladesh's population had access to electricity. Today, only 75% of the population has access to electricity with a per capita consumption of

electricity increased from 170 kWh in 2010 to 390 kWh in 2015 (Shakil et al., 2023). But there is a significant gap between supply and demand. As on April-2016, total installed capacity is 12,339 MW (Public Sector 6,440 MW, IPP, SIPP & Rental 5,299 MW & Power Import 600 MW). Power Plants are located at different parts of the country. The main fuel used for power generation is indigenous gas. The maximum power generation history is 8776 MW on June 15, 2016. The transmission network is 9,695 circuit km long comprising 230 KV, 132 KV and 66 KV lines. The total numbers of grid sub-stations are 131 and the total capacity is 24,670 MVA as on June-2015 (Debnath et al., 2023). In general, rapid industrialization and urbanization has propelled the increase in demand for energy by 10% per year (Shabir et al., 2022).

The government has set up the goal of providing electricity to all by 2030 and to ensure reliable and quality supply of electricity at a reasonable and affordable price. Development of Renewable Energy is one of the important strategies adopted as part of Fuel Diversification Program. With Renewable Energy policy 2009, the Government is committed to facilitate both public and private sector investment in Renewable Energy projects. The Renewable Energy Policy envisions that 5% of total energy production will have to be achieved by 2015 and 20% by 2025. The government has already launched the “500 MW Solar Power Mission” to promote the use of Renewable Energy to meet the increasing demand of electricity (Shakil et al., 2022). The need is undeniable, that much is certain for electricity is increasing rapidly with the improvement of living standard, increase of agricultural production, progress of industries as well as overall development of the country.

2. Demand and Supply Gap of Energy in Bangladesh

On 6 January 2009 power generation was 3267 MW against national demand of 5200 MW (Islam et al., 2014). But there is a significant gap between supply and demand. The total capacity of our country is 12339 MW (April-2016) while the total supply is 6742 MW against demand of 7344 MW Day peak and 8049 MW against demand of 8236 MW Day peak (03/06/2016) (Shakil et al., 2023). Due to shortage and unreliable power between demand and supply, sustainable economic growth has been constrained. It has been observed that almost half of the electricity is consumed by the domestic appliances. Average household appliances consist of Light, Fan, Refrigerator, Television, Radio, Stereo Players, Computers, Laptop, Air-conditioner, and Water pump, Cooking Devices etc. Most of them are not energy efficient. Improving of the efficiency of household appliances, use of power by average household appliances will reduce and consequently will reduce the maximum demand of consumers; this may assist to reduce the differences between available power and the maximum demand of a city as well as of the country. Figure 1 show the “Demand-Supply Gap” in power sector in Bangladesh (Shakil et al., 2023).

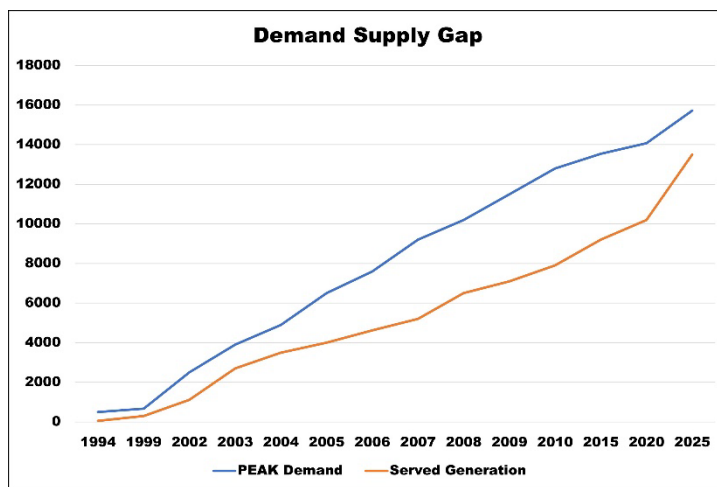


Figure 1. Demand-Supply Gap in power sector in Bangladesh (BPDB., 2021).

3. Power Sector Success Story of Recent Period

This is the period when the present government came to power through a massive popular mandate and declared power sector as the priority agenda of this government and launched a comprehensive program in easing the power crisis and rid the people of frequent power outages. Short-term, mid-term and long-term plans were prepared under a massive Master Plan to take the generation of power to match the huge need by 2030 when the country aims at turning

into a mid-income nation. Significant achievement has already been made by raising the power generation capacity to the current level 16339 megawatt from just 6334 megawatts seven years ago. The contribution of quick rental power in this respect is appreciable. The maximum power generation is 9036 MW on June 15, 2016. Electricity generation status of present government shown in figure 2.

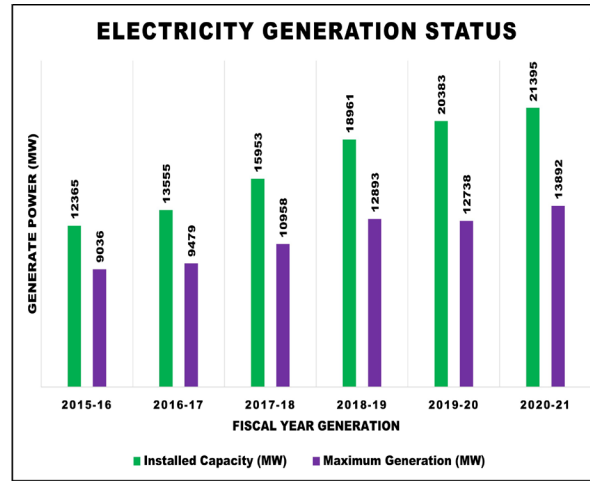
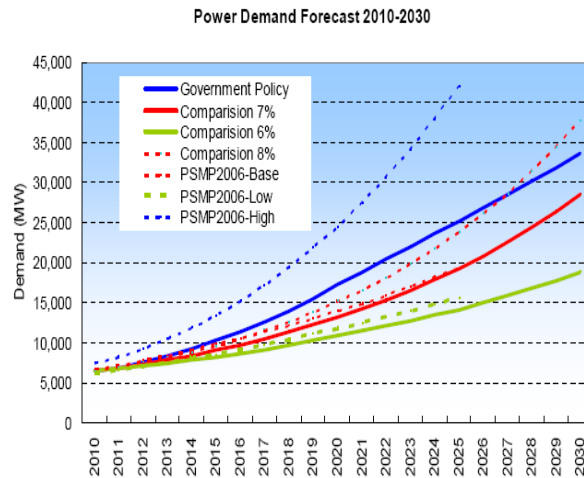


Figure 2. Electricity Generation Status of present government (Source: BPDB., 2021).

4. Projected Energy Forecast Scenarios in Bangladesh

In the first step of PSMP 2010, the power demand will be forecast using a similar method as that used in PSMP2006. The adoption scenarios of the power demand forecast in this MP are as shown in the Figure 3. The figure indicates three scenarios; (i) GDP 7% scenario and (ii) GDP 6% scenario, based on energy intensity method, and (iii) government policy scenario (Amin et al., 2022).



Source: JICA Study Team

Figure 3. Three scenarios for power demand forecast (Jacobsson et al. 2000).

5. History of Solar Home System in Bangladesh

The SHS is the primary location where PV technology is being used in rural Bangladesh. Over the last several years, off-grid electricity in rural areas using SHS has grown in popularity. In 1997, the Rural Electrification Board (REB) undertook a pilot project in Narsindi with funding from the French government. Following the success of REB's first "Diffusion of Renewable Energy Technologies" and "Rural Electrification through Solar Energy" programs, a total of roughly 13,000 SHS were spread under the "fee for service" concept. The REB pilot project in Narsindi was so

successful that it inspired other non-governmental organizations to launch their own SHS diffusion initiatives. Grameen Shakti (GS) began its first commercial efforts with SHSs in 1997, using both "cash sale" and "credit sale" strategies (Bhattacharyya., 2015). Infrastructure Development Company Limited (IDCOL., 2015) was established in 1997 by the Government of Bangladesh (GOB). In 2002, the International Development Association (IDA), the Global Environment Facility (GEF), and the German KfW and GIZ began funding the "Rural Electrification and Renewable Energy Development Project" (REREDP), marking the beginning of a new phase of SHS promotion that will last until 2009. Large and medium-sized infrastructure and renewable energy projects in Bangladesh would not be possible without IDCOL's help in securing funding. In terms of financing for energy and infrastructure projects in the private sector in Bangladesh, the firm has established itself as the market leader. IDCOL helps to spread SHSs through its network of 47 Partner Organizations (POs), which includes large, seasoned NGOs like Grameen Shakti (GS), the Bangladesh Rural Advancement Committee (BRAC), the Rural Services Foundation (RSF), Solaren, and many more, in addition to many smaller, nascent NGOs and businesses.

6. Present Scenario of Solar Energy in Bangladesh

IDCOL a government-owned financing institution implements the program. "This is the fastest-growing solar home system in the world," a representative of the company says enthusiastically, "and with 50,000-60,000 new installations per month, the project is in high demand." With about 3.9 million homes and generation capacity to produce more than 150 MW electricity 25 million Bangladeshis now have electricity with solar home systems. This means that besides reducing carbon emissions, these systems will help children at home, provide electricity for lighting, make it safer for women to walk at night, reading, watching TV, charging mobile phones and other low load appliances (Shakil et al., 2023). Around 80% of the villagers benefited from the solar panel systems with access to electricity (Madiha., 2023). So, majority of solar power utilization is done in rural areas. Its potential in the urban area is less addressed issue. Although more expensive than national grid electricity, people now prefer solar home systems to equip their home or business places. Now accustomed to and comfortable with use of electricity the rural people need more reliable and increased supply of solar energy. Therefore, the demand for renewable and grid power supply arrangement is gradually on increase. According to the government sources nearly 3% of the total requirement is presently met by renewable energy sources. Government's aim is to increase this, to the amount of 10% by 2020 and to 20% by 2030. By 2021 a total of 3 thousand 174 megawatts of electricity generation from renewable energy is planned by SREDA (Shabir et al., 2022). Figure 4 show Solar home system installation growth in Bangladesh.

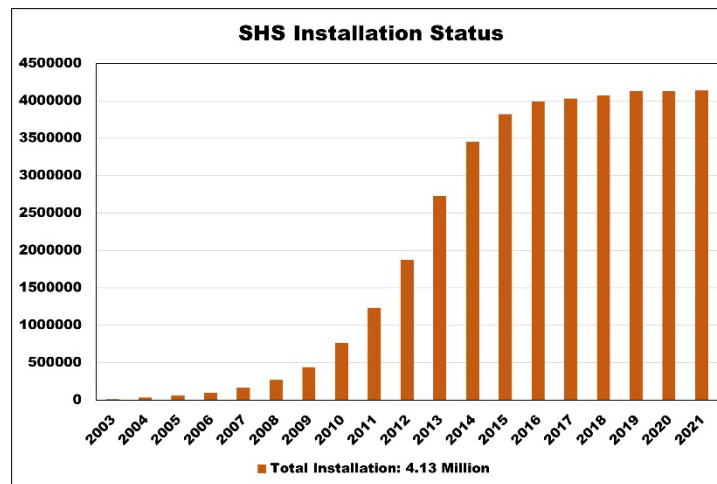


Figure 4. Solar Home System installation growth in Bangladesh (Source: IDCOL., 2015).

7. Various Problems Hinder the Growth of Solar System

A common criticism is that SHS often do not benefit the poorest of the poor, as they cannot afford high upfront costs. In most of the cases, the solar energy sector is facing problems with sub-standard solar panels and battery. There are complains that the battery quality is not up to mark to achieve satisfying performance. Insufficient warranty period of battery & inverter is another problem (Shabir et al., 2022). Bangladesh is currently importing almost all the solar panels; low-cost sub-standard panels are inundating the market. Instead of using high quality premium priced solar panels, most of the people are using cheap sub-standard brands and facing numerous troubles. In that process they are

losing their interest in using solar energy. Moreover, Information regarding use of solar energy is not readily available in the market (Ahiduzzaman et al., 2011).

However, solar panel installations on rooftops, which are now often required before a building can connect to the energy grid in metropolitan areas, have become commonplace in recent years. The Experts are concerned that the quality, effectiveness, and whether the panels are producing electricity at all are not examined. After buying power from 'Rental sources' the national grid authority pays little attention to the other sources like solar sources. Appropriate research for development of more efficient and durable solar panels are absent. Some private groups have been successful to keep their dominance in favors of rental power although much costlier than solar power (Tk. 14.5 per unit) (Shabir et al., 2022). Therefore, it appears that appraisal, incentives to encourage the development of solar and other renewable sources of energy structure needs to be enhanced. Private investors in renewable energy sectors should be encouraged to work for development and innovation by allowing tax exemption or subsidy, which will make the power authority beneficent in the long run (Shabir et al., 2022).

8. Why Use Solar Power

The main sources of world's energy generation are the fossil fuels (gas, oil, coal) and nuclear power plants. Due to the usage of fossil fuels, greenhouse gases (CFC, CH₄, O₃, but mainly CO₂) emit into the atmosphere. From the nuclear power plant, carbon is released in a small amount (90 grams equivalent of carbon dioxide per kilowatt hour) (Shabir et al., 2023). But the radioactive waste remains active over thousand years which is a potential source of environmental pollution. On the other hand, there is an alarming energy crisis worldwide as fossil fuel reserves decrease, and the ageing power plants are going to close in near future. From the aspect of global warming and shortage of natural gas, scientists and engineers are looking for clean, renewable energies. Solar energy is one of the best options (Shabir., 2023).

Bangladesh is facing an acute shortage of energy. Natural gas is the main source of electricity generation in Bangladesh. But the limited gas reserves cannot fulfil the necessities of both domestic requirements and industrial and commercial demands, especially demands for electricity generation for long. Solar energy is the most suitable form of energy for Bangladesh. Solar energy does not need national grid, no need for national infrastructure or high technical skill to use. Above all, solar panels can be installed at outlying areas in small houses, shops, schools etc. and are very cost effective (Madiha., 2023).

9. Scope of Solar Energy in Bangladesh

Bangladesh, where nearly 75 percent of the area is rural off-grid have been hindered in their development and progression by inadequate, limited or no access to electricity (Ahmed et al., 2014). Bangladesh is facing an acute shortage of energy. Due to this shortage of electricity not only we are facing load shedding across the country but also the industrial sector is badly affected, resulting in reduced industrial output and diminished export earnings. There is a rising demand on the energy sector for rapid industrialization, urbanization, high population growth, increasing food production, rising standard of living etc. Solar energy could be a major source of power generation in Bangladesh.

For many individuals in rural areas, it makes financial and ethical sense to use a modest renewable energy system that is not linked to the electrical grid to power their homes or small enterprises. This kind of system is known as an off-grid system or a stand-alone system. It may be more cost-efficient to use a standalone system in an outlying area than to run an electrical connection there. However, individuals who are close to the grid use them too, either to gain autonomy from their utility provider or to show their dedication to clean energy.

10. Prospect of Pilot Nano Grid Technology

The concept of Nano-grid is based on the idea of SHS in which the basic electricity needs of the households (consumptive load) are met, but at the same time it proposes the incorporation of some small scale agricultural or commercial applications (like irrigation).

This takes advantage of the fact that houses are frequently clustered together in rural areas in groups of 40-50 houses within a diameter of less than 500m. In the Nano-grid system, a basic 1.5 to 3 kWp PV system is installed in a small cluster of households within a short radius of each other (ideally 230-250m) and power is distributed to the households from this system (Datta et al., 2023). The generation and storage of this system is 48 Volt DC. System has a DC-to-DC converter, and its output is 220 Volt DC. This system has an option of DC (220V) to AC (220V) conversion. The payment method for the consumer is pay per unit energy (ex. pre-paid meter) (Shabir et al., 2022).

11. Prospect of Intelligent Delta Charging

Intelligent delta charge control is a brand-new technology which may redefine the practice of using solar energy commercially or privately. The intelligent monitoring system constantly surveys the sun, load, and battery condition to determine whether to run load without discharging battery directly from solar, charge battery if battery is low, or discharge battery when there is no sunlight (Figure 5 and 6) (Madiha., 2023).



Figure 5. Pilot Nano Grid Technology. [Source: Solaric]

11.1 Features

- Delta maintains controlled battery charging and discharging.
- Run loads directly from solar without battery.
- LCD (16*2) display.
- Very low self-power consumption.
- Long lifetime.
- Easy to operate.
- Protection: short circuit, overload, reverse polarity.
- Sun condition monitoring
- Reset option to get back to default.

11.2 Applications

- DC solar grid system.
- Commercial institutions (bank, corporate offices).
- Solar irrigation system.
- Industrial facilities.

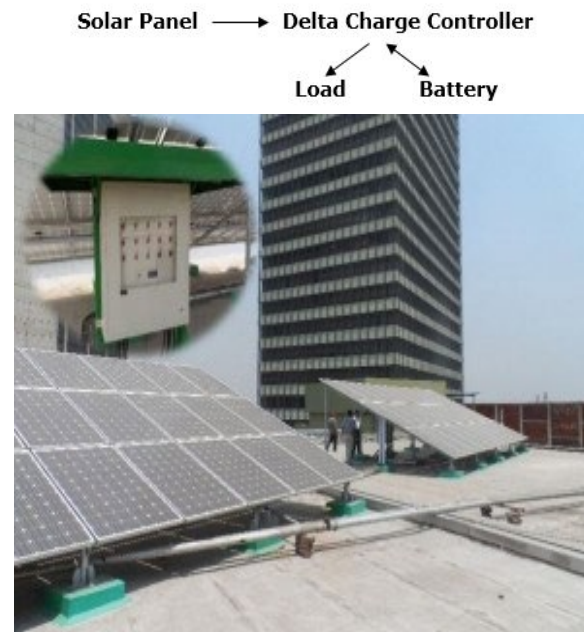


Figure 6. Intelligent Delta Charging System [Source: Solaric].

12. Conclusion

Rural electrification through Solar home System is becoming more popular, day by day in Bangladesh particularly for remote, inaccessible areas. But the intensified competition challenges make the customers satisfaction an essential prerequisite for the achieving a sustainable competitive advantage and, hence, the Solar Home Systems industry's overall success. As in today's competitive environment service marketers put great effort on developing customer satisfaction to maintain competitive edge research can be undertaken for outlining of what needs to be done to improve the service of the Solar Home Systems in Bangladesh. For that purpose, the researcher tried to judge its customer satisfaction with this research. The findings suggest that the service provided by Solar Home Systems has far-reaching effects on the economic, social, and demographic conditions of rural Bangladeshi society. It has significant and sustained impact on household and commercial activities. And by watching TV people are now keeping informed about the latest state of sports, culture, and political developments. Most of the respondents are found just satisfied with the Solar Home System in Bangladesh. They are found dissatisfied with some service quality variables like convenient use of the system, longevity of the SHS, sustainability of the SHS, availability of loan from the system providers, maintenance cost of the system, warranty support of the SHS, credibility of the providers, friendly behavior of the personnel, the leaflet, catalogue etc. provided with the system and availability of the parts of the system in the local market. So, the service providers should take proper care of these variables to improve the overall service quality of SHS service in Bangladesh.

The service providers should offer a good quality system at a reasonable price with adequate capacity and longevity to meet up the requirements of the customers. Moreover, they should maintain a better after sale service at reasonable cost for the customers for convenient use of the systems and arrange training on technical and better service delivery to their personnel. After accounting for the study's limitations, its conclusions may be extrapolated. This research focuses on people who have installed solar panels in their homes in the Rajshahi Division. To our knowledge, this is the first research to focus on the customer's point of view. Improvements to the quality of the Solar Home System service in our nation are possible if further studies verify, reinforce, and corroborate the results of this investigation while also providing different strategic direction.

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