

The Present Scenario of Solar Home Systems (SHSs) and Future Utilization in Bangladesh

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Abstract—As a country of acute power crisis, Bangladesh is now looking forward to develop its renewable energy sources. This paper presents the state of the 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 specially 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 — IDCOL, SHS, BPDB, REB, PSPM, IPP, GDP, GOB, REREDP, IDA, GIZ, 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.

Electricity utilization in this region (Bangladesh) started in 1901 when a private generator was installed at the residence of the then Nawab of Dhaka. Mr. Bolton, British citizen, switched on the first electricity in Ahsan Monjil on 7 December 1901. Electricity distribution system under private ownership was begun by DEVCO, a subsidiary of Octavian Steel Company in the 1930s and Dhanmondi power house was setup for commercial distribution of power.

In 1972, Bangladesh Power Development Board (BPDB) was created to boost the power sector. A different approach and a new model was 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 [2, 3].

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[1, 4, 5]. 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 is 8776 MW in June 15, 2016. The transmission network is 9,695 ckt 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 [6]. In general, rapid industrialization and urbanization has propelled the increase in demand for energy by 10% per year [7].

Government has set up the goal of providing electricity to all by 2020 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

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investment in Renewable Energy projects. The Renewable Energy Policy envisions that 5% of total energy production will have to be achieved by 2015 and 10% by 2020. Government has already launched "500 MW Solar Power Mission" to promote the use of Renewable Energy to meet the increasing demand of electricity [8].

There is no doubt that the demand 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 [9]. 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) [10].

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 show the "Demand-Supply Gap" in power sector in Bangladesh.

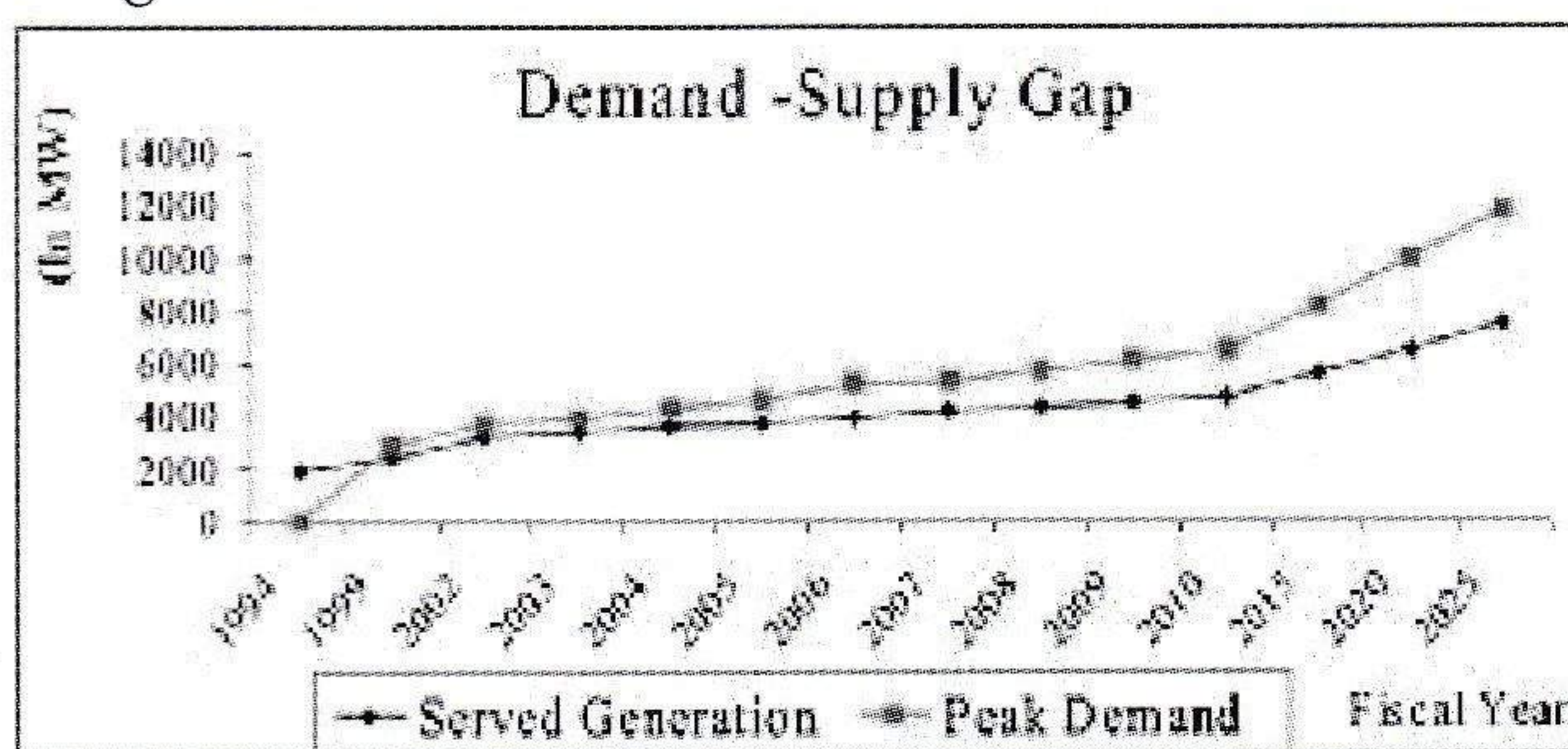


Fig. 1 Demand-Supply Gap in power sector in Bangladesh [5].

3 POWER SECTOR SUCCESS STORY OF PRESENT GOVERNMENT

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 2021 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 12339 megawatt from just 6334 megawatt seven years ago. The contribution of quick rental power in this respect is appreciable. The maximum power generation is 8776 MW in June 15, 2016.

Electricity generation status of present government showed in figure 2.

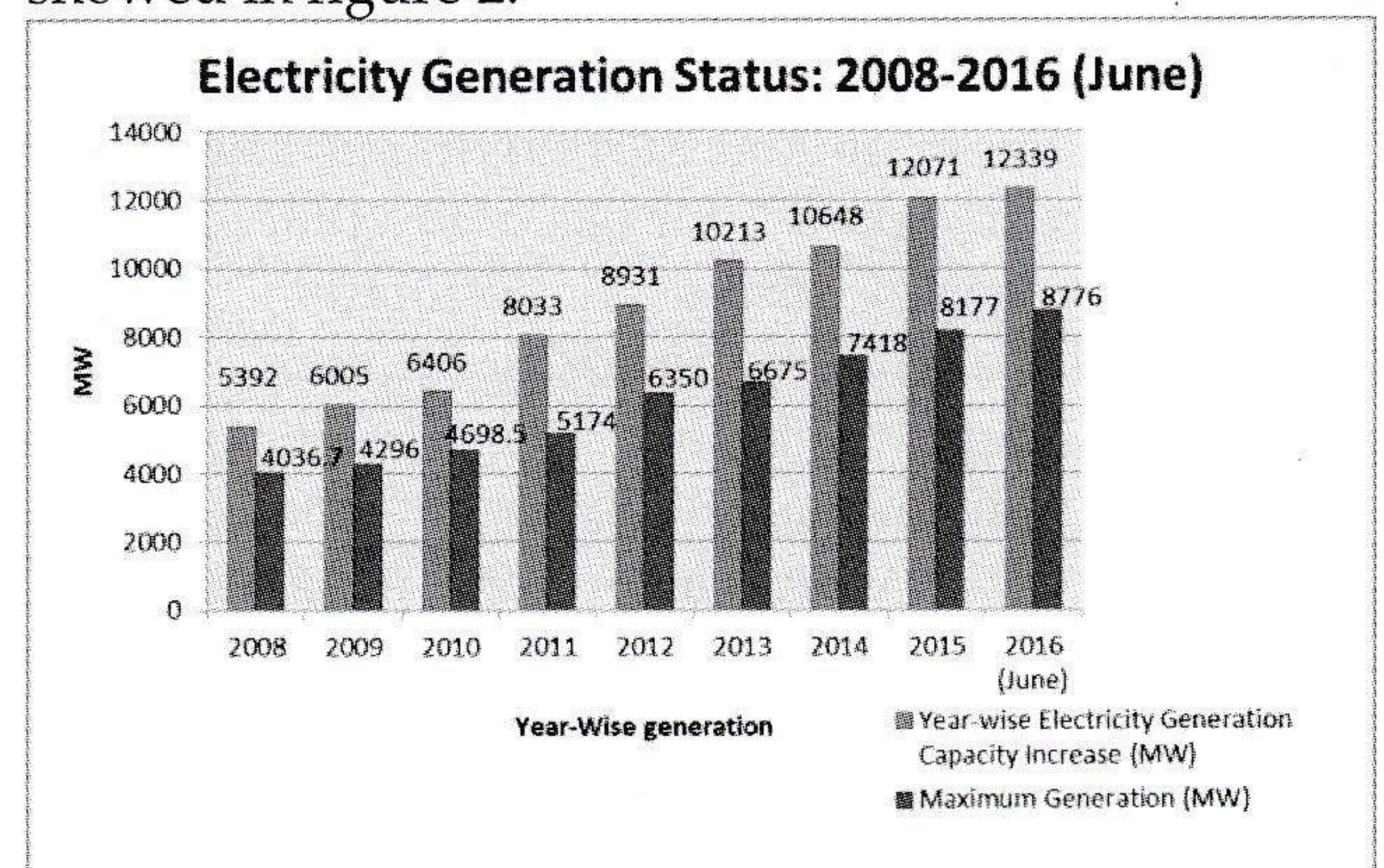
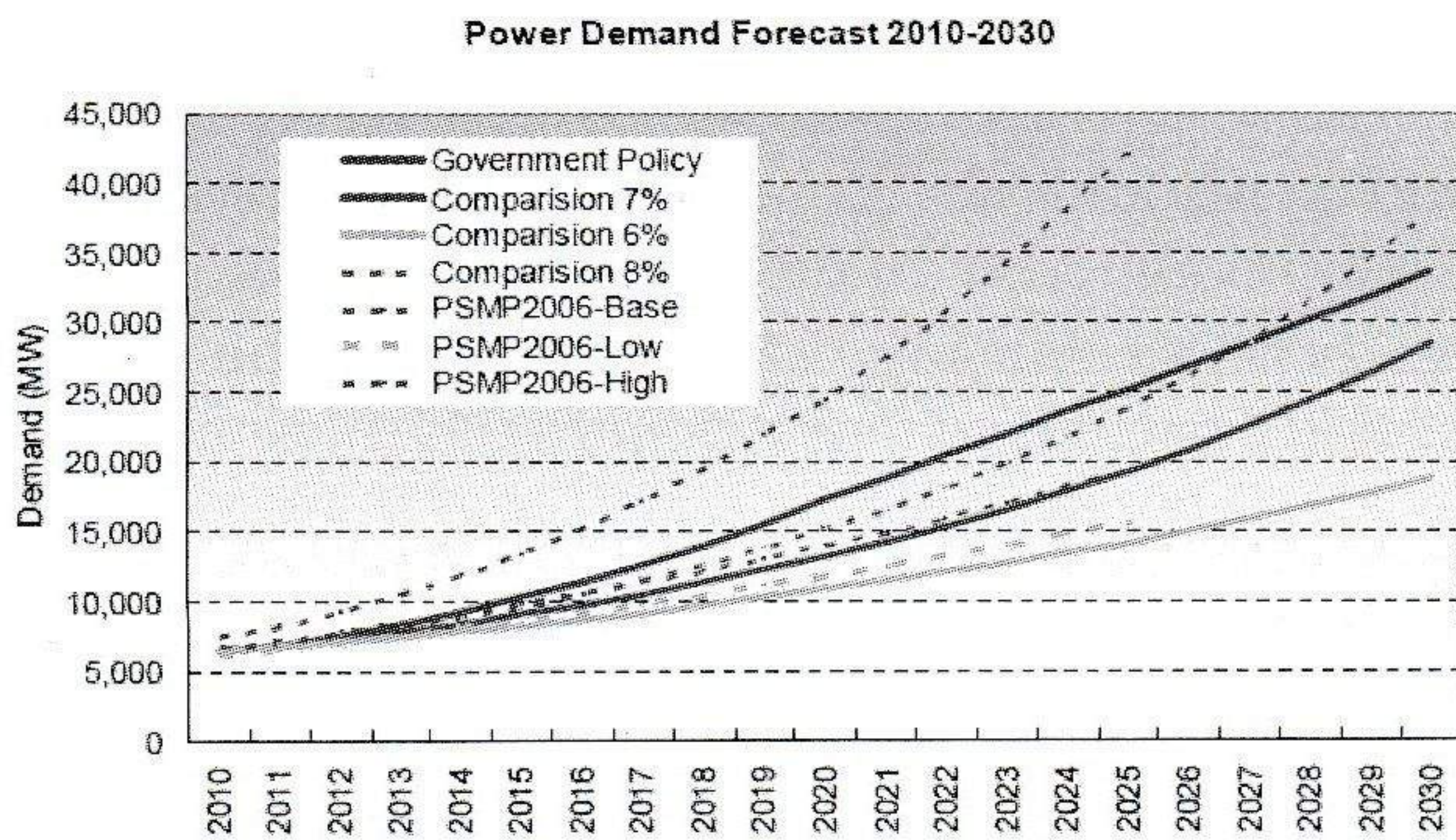


Fig. 2 Electricity Generation Status of present government (Source: BPDB).

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 [7].



Source: JICA Study Team

Fig. 3 Three scenarios for power demand forecast [3].

5 HISTORY OF SOLAR HOME SYSTEM IN BANGLADESH

The main application of PV technology in rural Bangladesh is the SHS. The use of SHS for rural off-grid electrification has become very popular during the last years. Following the initial experience from a French-funded pilot project in Narsindi implemented by the Rural Electrification Board (REB) in 1997. REB's follow-up projects "Diffusion of Renewable Energy Technologies" and "Rural Electrification through Solar Energy" about 13,000 SHS were disseminated using the "fee for service" model. Encouraged by the success of the REB pilot project in Narsindi, NGOs soon went ahead with their own SHS dissemination programs. First commercial activities with SHSs were initiated by Grameen Shakti (GS) in 1997 following "cash sale" and "credit sale" approaches. Infrastructure Development Company Limited (IDCOL) was established in 1997 by the Government of Bangladesh (GOB). A new phase of SHS promotion started in 2002 with the implementation of the "Rural Electrification and Renewable Energy Development Project" (REREDP), which is jointly financed by the International Development Association (IDA), Global Environment Facility (GEF), German KfW and GIZ over year 2002 to 2009. IDCOL is playing a major role in bridging the financing gap for developing medium and large-scale infrastructure and renewable energy projects in Bangladesh. The company now stands as the market leader in private sector energy and infrastructure financing in Bangladesh.

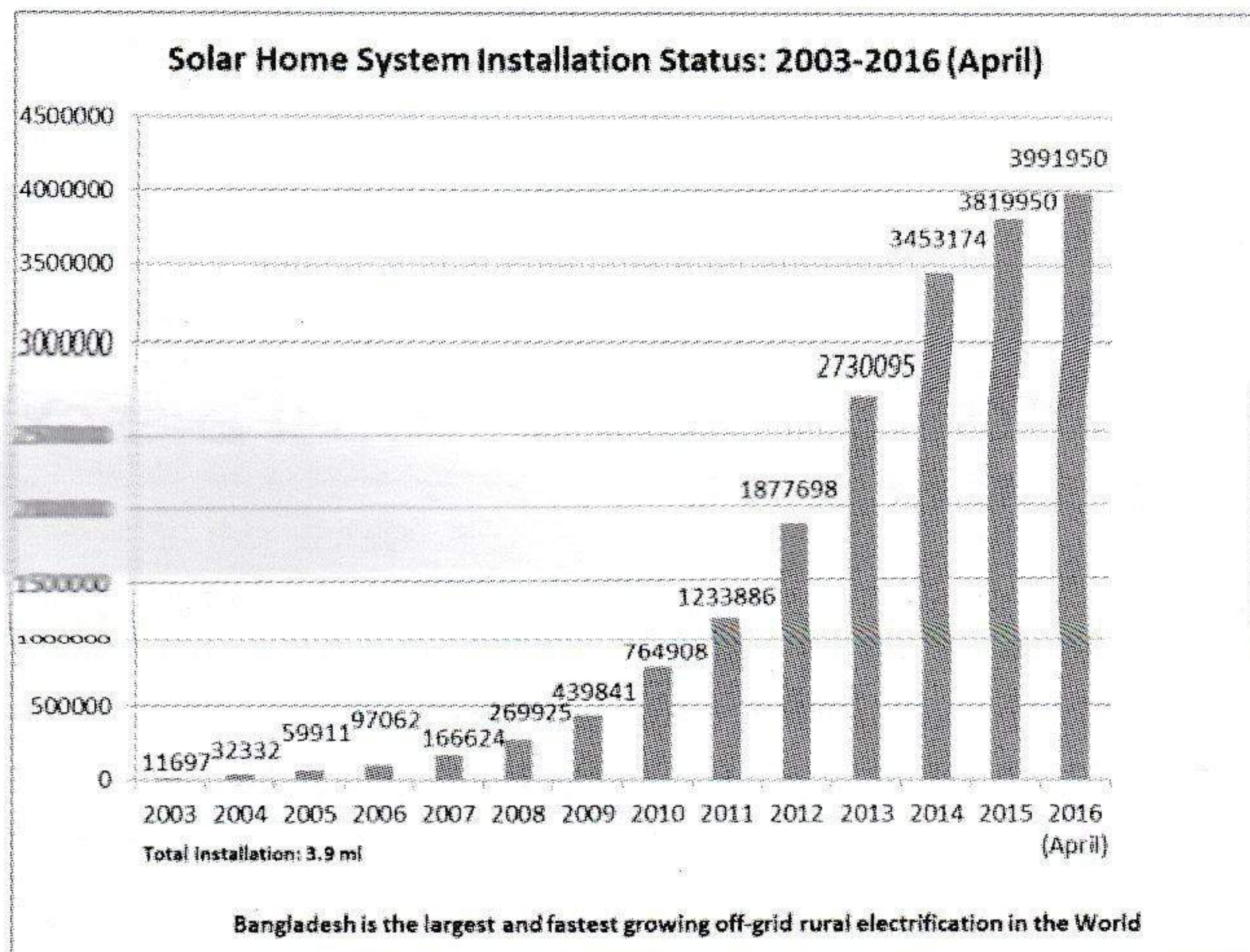
IDCOL supports to disseminate SHSs through 47 Partner Organizations (POs), namely experienced NGOs such as Grameen Shakti (GS), the Bangladesh

Rural Advancement Committee (BRAC), Rural Services Foundation (RSF), SolarEn, as well as a number of smaller NGOs and private enterprises [11].

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 (April, 2016) million homes and generation capacity to produce more than 150 MW (Daily Prothom alo) 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 [12, 13]. Around 80% of the villagers were benefited from the solar panel systems with an access to electricity [14]. So it is clear that 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 [15]. Figure show Solar home system installation growth in Bangladesh.



7 VARIOUS PROBLEMS HINDER THE GROWTH OF SOLAR ENERGY

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. 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 [16].

However, the connection to the electricity grid in the urban areas requires the installation of the solar panels on the roof of the building as a precondition; have been established in the past few 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 researches for development of more efficient and durable solar panels are absent. Some private groups have been successful to keep their dominance in favour of rental power although much costlier than solar power (Tk. 14.5 per unit). 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[17].

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) [18]. 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 the one of the best options.

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 is very cost effective.

9 SOLAR ENERGY IS THE BEST SOLUTION TO REMOVING ENERGY CRISIS 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 [19]. 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. In rural area many people, powering their homes or small businesses using a small renewable energy system that is not connected to the electricity grid called Off-grid system or stand-alone system makes economic sense and appeals to their environmental values [20].

In remote locations, stand-alone systems can be more cost-effective than extending a power line to the electricity grid. But these systems are also used by people who live near the grid and wish to obtain independence from the power provider or demonstrate a commitment to non-polluting energy sources.

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. 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) [21].

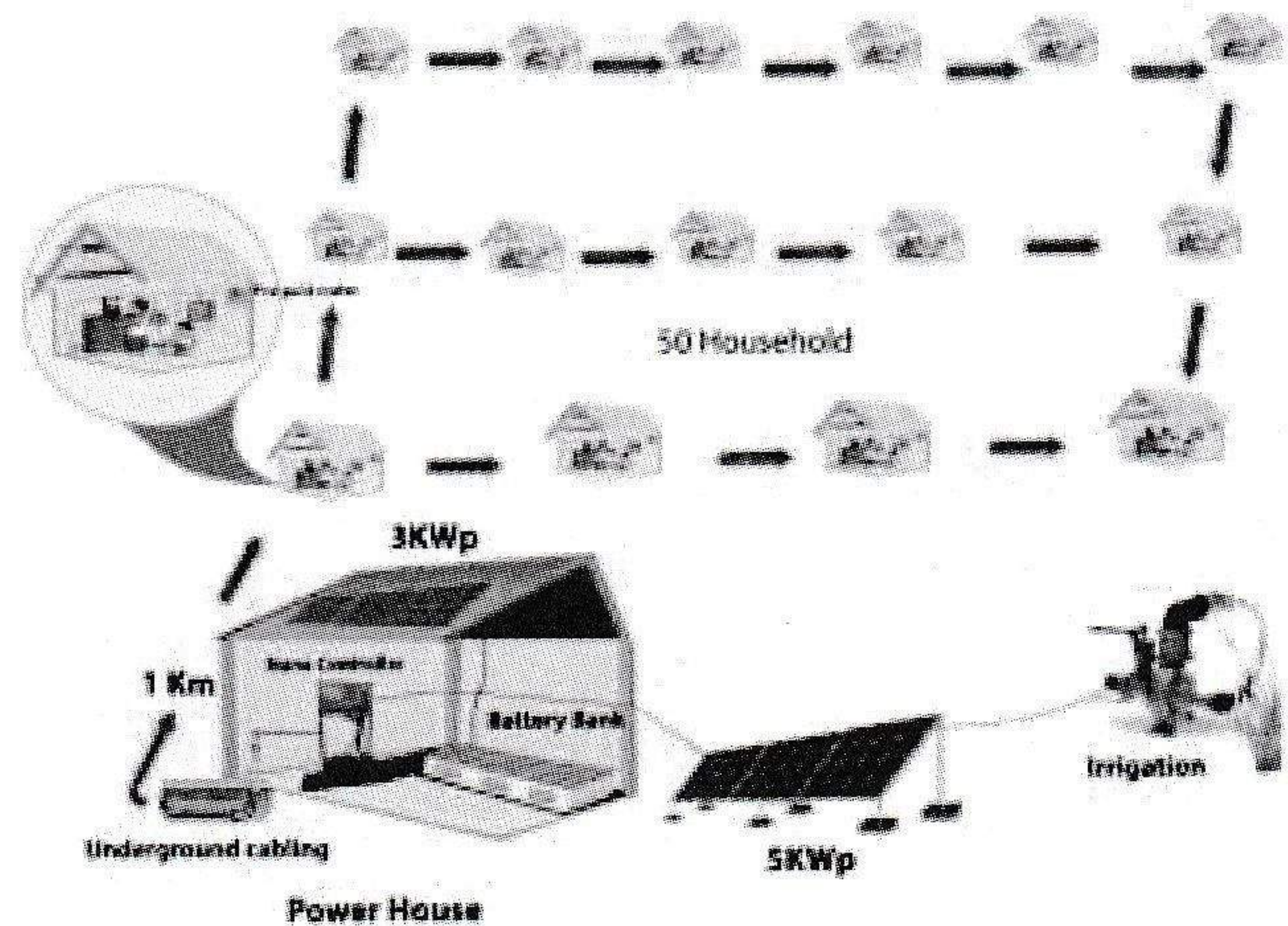
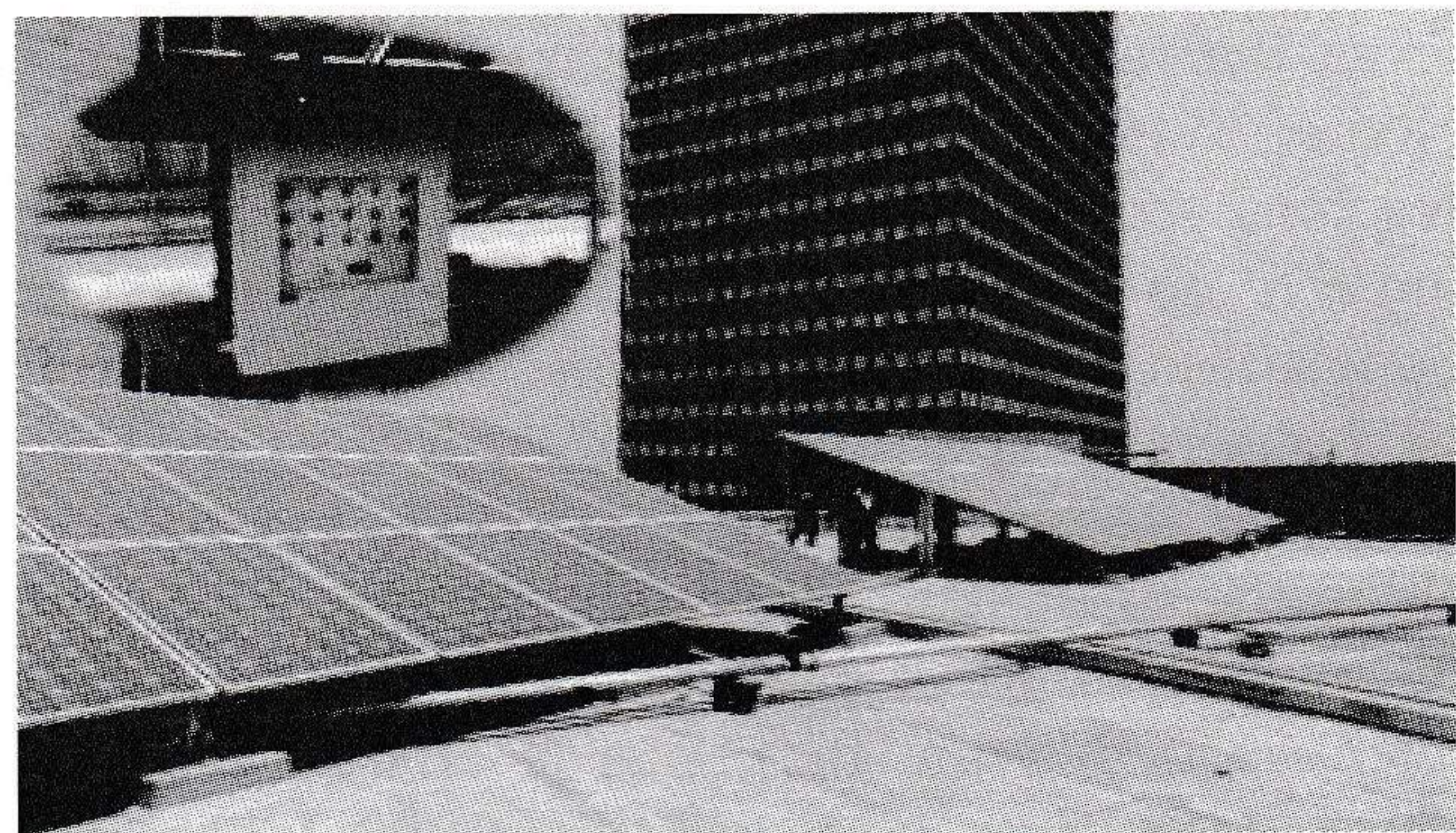
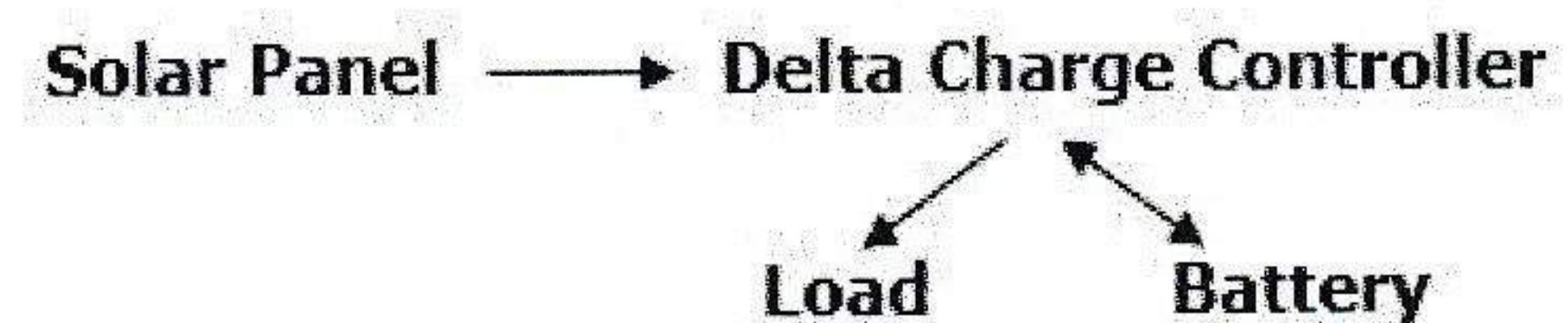


Fig. 5 Pilot Nano Grid Technology. [Source: Solaric]

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 [22].

11.1 Easy Operation



Picture: Intelligent Delta Charging System [Source: Solaric].

11.2 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 life time
- Easy to operate.
- Protection: short circuit, overload, reverse polarity.
- Sun condition monitoring
- Reset option to get back to default.

11.3 Applications

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

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 in order 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. From the research it may be concluded that Solar Home System service has profound and far-reaching economic, socio-cultural and demographic impacts on life and living of the rural people in Bangladesh. 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 behaviour 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 also arrange training on technical and better service delivery to their personnel. The findings of this study may be generalized after taking into consideration certain limitations. This study considers only the users of Solar Home Systems in some areas of the Rajshahi Division. To the best of the knowledge this study is the first of its kind based on the customer's perspective. When such studies confirm, support, and strengthen the findings of this research and offer additional strategic guidance, the Solar Home System service in our country could be significantly improved.

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