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Setting the sun on off-grid solar?: policy lessons from the Bangladesh solar home systems (SHS) programme

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ABSTRACT

After decades of growth, the Bangladesh Solar Home Systems (SHS) programme, the world's largest domestic solar off-grid electrification scheme which has frequently been heralded as a model for other developing countries, is in danger of collapsing as end user support and installation levels have plummeted. This paper explores the reasons behind this development, tracing the programme run by the Infrastructure Development Company Limited (IDCOL) from its early expansion employing pioneering partnership and financing models, to its more recent decline. It finds that the government's simultaneous implementation of several competing on- and off-grid energy access projects and lack of regulatory oversight alongside significant subsidy decreases which made SHS uncompetitive, led customers to abandon the programme. This, in turn, is putting at risk Bangladesh's objective of achieving Sustainable Development Goal (SDG) 7 – affordable, reliable, sustainable and modern energy for all – by 2030.

KEY POLICY INSIGHTS:

- The intended maturation of the market for off-grid solar did not occur alongside the gradual reduction of the SHS programme's subsidy scheme. This resulted in a lack of service and technology providers and continued high system prices, unattainable to poor households in rural Bangladesh.
- The Government of Bangladesh's unexpected grid expansion into SHS areas and introduction of free solar energy systems in 2015 further undermined the programme because it led to:
 - customer's turning away from SHS and defaulting on their loan payments, leading to financial problems for IDCOL's partner organizations.
 - entry of unregulated sub-standard panels into the market, resulting in a lack of confidence and distrust in the SHS by end-users.
- A key role of the government is to ensure the sound quality of the systems and services from the outset to instil customer confidence in the product.
- The creation of successful long-term energy access requires a comprehensive, integrated approach to coordinate stakeholders and oversee market development over time, ensuring that markets for new technologies and services such as SHS have an opportunity to succeed.

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Introduction

Providing affordable, reliable, sustainable and modern energy for all is both a major objective and challenge for Bangladesh, with approximately 40 million people, or roughly a third of the country's population, living without reliable energy access due to their remote rural location and low solvency levels (Ahmed et al.,

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2020; Gunatilake & Roland-Holst, 2013; WB, 2020). This paper examines the development and current status of the Bangladesh Solar Home Systems (SHS) programme operated by the government-owned intermediary Infrastructure Development Company Limited (IDCOL) with the goal of achieving universal energy access through rural electrification. Since the establishment of IDCOL in 1997, off-grid solar (OGS) solutions have been one of the most significant contributors to reducing Bangladesh's energy deficit (MPEMR, n.d.; Sanyal et al., 2016). In 2013, at its peak, the SHS programme installed over 861,000 OGS units and in 2018 provided a total of 20 million people, or nearly 12.5 percent of the country's population at the time, with renewable electricity (Cabraal et al., 2021). From 2015 onwards, however, new annual installations declined dramatically as customers defaulted on their loan payments and abandoned the programme, following gradual cuts to its subsidy scheme and the government's introduction of a competing free solar energy system (Cabraal et al., 2021; Hossain, 2018). The paper traces the SHS programme from its early expansion employing pioneering partnership and financing models, to the more recent collapse in the number of new installations. It reviews the programme's funding structure and assesses the impact of key policy interventions in the OGS market. The paper concludes with a number of lessons to be drawn from the SHS programme's chequered history.

Early growth of the SHS programme

The SHS programme is credited as the largest domestic OGS electrification programme in the world (Ahmed et al., 2020; Saim & Khan, 2021). Its many successes read like a 'best of' of small-scale renewable off-grid solutions: The programme's initial target of reaching 50,000 homes over five years was met after only three years and at its height, it managed to install more than 80,000 units every month. By early 2019, more than 4.1 million SHS had been deployed, providing millions of Bangladeshis with low-carbon electricity. But these impressive outcomes could not have been predicted when IDCOL was set up in 1997. The government-owned company's original role was to support medium- to large-scale infrastructure projects, including larger renewable energy power plants, with the foray into OGS, following a request by the World Bank, seen as an 'accidental and reluctant' move (Arc Finance, 2014).

The programme's rapid expansion from 2003 onwards was made possible through the use of innovative microcredit schemes combined with a vast network of partners arranged through a public-private-partnership (PPP) model enabling service provision throughout the country (IDCOL, 2018; Rahman & Ahmad, 2013). The utilization of this microfinance-based PPP model sustained the SHS programme for over a decade and enabled a scaling-up of investment into OGS, providing vital energy access services to rural communities (Hossain, 2018; Newcombe & Ackom, 2017). The PPP model (see Figure 1), designed from the outset to eventually become a self-sustaining model with the initial help of subsidies and government grants (Khan & Rabbi, n.d.; GoB, 2013), relied on an increasing number of partner organizations (PO) to join the effort over time. These POs are microfinance institutions active in local areas which, furnished with financing and technical assistance by IDCOL, connect SHS suppliers, local vendors needed to install systems, and end consumers who purchase SHS on a credit basis (Khan & Rabbi, n.d.; Ahmed et al., 2020).

Initially, these consumers had to be convinced to take up SHS due to widespread fears that solar systems, once bought and installed at home, would not work any longer. In response, IDCOL launched a public marketing campaign involving tv spots, roadside billboards and flyers, and supported its new POs with training and institutional support such as motorcycles and computers (Tiedemann, 2015). Beyond this, the PPP structure allowed IDCOL to provide ongoing technical assistance and support to its customers through the POs and after sales services to ensure a full-service package, including maintenance of the systems (IDCOL, n.d.; Hossain et al., 2021). Presently, IDCOL has 56 POs (see Appendix). Of these, Grameen Shakti is the largest provider of soft loans and credits to end consumers, maintaining a 60 percent share of all service provisions under the SHS programme (IDCOL, 2018). Making the PPP work was in no small part due to Grameen Shakti's ability to create a network of local entrepreneurs offering installations and services and to the soft credit schemes offered by Grameen Bank (Köhn, 2012; Newcombe & Ackom, 2017).

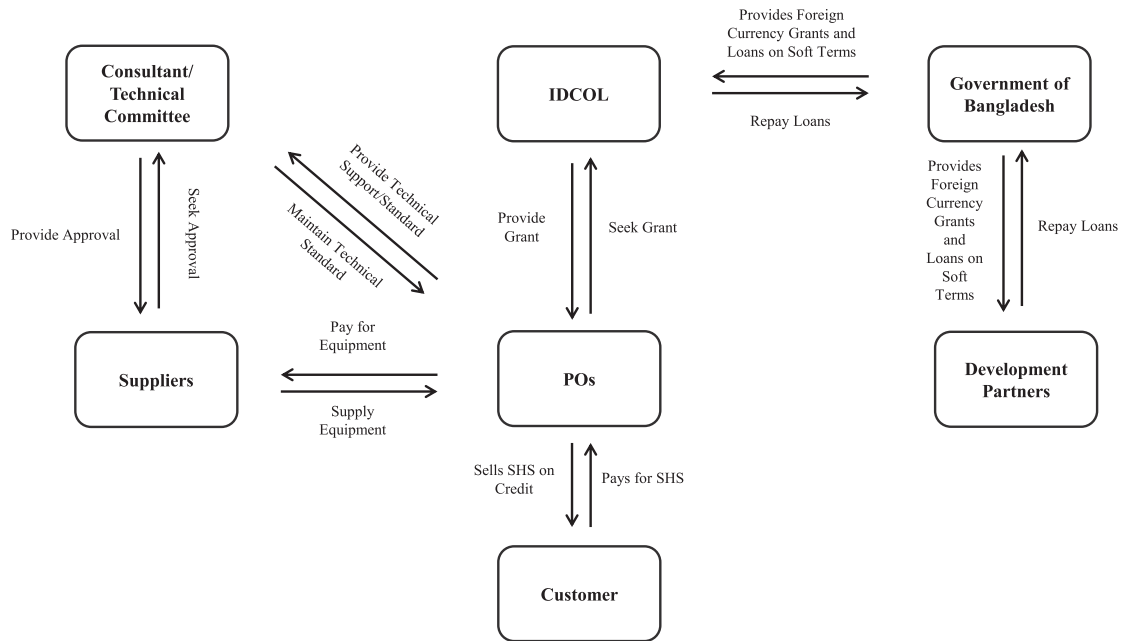


Figure 1. PPP-model adapted from Cabraal et al., 2021, p.xix; Hossain et al., 2021, p. 491.

Funding structure of the SHS programme

The SHS programme received start-up funding from the World Bank and Global Environment Facility in the form of credit and grant support (WB, 2019; IDCOL, n.d.). Thereafter, IDCOL received financial support from various international development finance institutions¹ (Ahmed et al., 2020; Sanyal et al., 2016) that enabled the expansion and maintenance of the programme (IDCOL, 2018). IDCOL's approach focuses on result-based financing that involves private donors and NGOs to build a market infrastructure under donor assistance (Sanyal et al., 2016). IDCOL channels the aid and grants received from donors to its POs in the form of capital buydown grants by creating a generous credit line to the POs to refinance their microfinance loans (Khandker et al., 2014; Schaefer, 2017). The grants are subsequently passed onto the customers in the form of a lower SHS unit price, encouraging OGS system uptake in remote areas (Khandker et al., 2014). The innovative financial model of IDCOL is the enabling factor behind the wide SHS adoption rates throughout Bangladesh, providing people who typically would not qualify for loans or credit from commercial banks with the possibility to affordably finance a solar home system (Ahmed et al., 2020; Sanyal et al., 2016).

Of the USD 696 million donor investment in IDCOL, USD 600 million are provided in the form of loans and the remaining USD 96 million are covered by grants (Ahmed et al., 2020). The arranged loan structure to the POs covers a twelve-year period, with a two-year grace period, a ten-year repayment timeline, and a 6 percent interest rate charged (Ahmed et al., 2020; Hossain et al., 2021). The POs are given the possibility of refinancing all credit extended to households. In this case, the POs receive a soft loan for six to eight years at a 6–9 percent interest rate, and 70–80 percent of this credit is extended to the end-user. This structure significantly helped the POs to strengthen and grow their market share (Hossain et al., 2021; Khandker et al., 2014). Such a credit model, enabled by IDCOL subsidies in the form of buydown grants, was designed with the intention of the SHS market to eventually become self-sustaining, functioning without subsidization and enforced by healthy competition in the sector (Newcombe & Ackom, 2017, p. 24).

The credit payments to the POs and the subsequent subsidies lowering the cost of SHS for customers were reduced gradually over time as the financing model of the SHS programme was unsustainable over the long-term (Hossain et al., 2021; Sanyal et al., 2016). The additional USD 90 offered per system at the programme's

inception in 2003 was gradually lowered to USD 20 for installations below 30 watts in 2013/2014 (Sadeque et al., 2014). Following the subsidy reduction and subsequent increase in the price of SHS units, installation numbers declined. Customers were now looking for cheaper commercial alternatives or, from 2015, hoping to benefit from a rapid new grid expansion as well as the Government of Bangladesh's (GoB) new free OGS system. In 2018, sales were down to only 1,000 units a month, driving the programme to the brink of collapse (Hossain, 2018). If the SHS programme is to continue in its current form and mandate, significant adjustments will have to be made (Ahmed et al., 2020; IEA, 2017).

Competing policies and the decline of the SHS programme

A number of reasons help to explain the decline of market investment and near collapse of the SHS programme. These include: first, the failure to create a competitive OGS market; second, a weak institutional framework; and third, the government's introduction of free rival OGS and on-grid systems. First, due to IDCOL being the sole external financier in the market in Bangladesh, the commercial banking sector has remained hesitant to provide financing for SHS (Sanyal et al., 2016, p. 23), hampering the OGS sector's development. This has led to demand-side market saturation and has forced POs to look for potential SHS opportunities elsewhere (Cabraal et al., 2021; Girdzijauskas et al., 2012; Khandker et al., 2014, p. 15). Furthermore, the lack of sufficiently developed capital markets (WB, 2019, p. 2) created significant barriers in introducing new players to induce competition (Karim et al., 2019).

Second, a weak institutional framework incapable of enforcing regulations is hampering private investment and the move towards green finance in Bangladesh (Volz et al., 2015, pp. 18–19). This has also lessened the risk appetite of private investors towards longer-time horizon OGS projects and prevented the formation of a viable commercial sector in its own right (*ibid.*). As the commercialisation of SHS did not occur as intended (Hossain et al., 2021), legitimate service and technology providers did not emerge as expected (Ahmed et al., 2020; Newcombe & Ackom, 2017). Instead, the exponential increase in the number of low-cost unregulated private market players has been a major challenge (Hossain, 2018; Newcombe & Ackom, 2017). Their unregulated sale of imported substandard panels has eroded consumer confidence in solar energy as a viable choice due to the lower efficiency and significantly shorter lifespan of the panels sold (Gupta, 2019; Islam, 2019).

Third, the GoB launched a number of additional projects to extend energy access to energy-deficient rural areas and meet the goals of its ambitious socio-economic development agenda. Its uncoordinated approach to rural electrification has caused significant challenges for the viability of the long-standing SHS programme (Cabraal et al., 2021; Hossain et al., 2021). In 2012, the GoB initiated its 500 MW Solar Project to scale-up renewable energy through solar mini-grids, solar rooftop and solar irrigation (SREDA, 2021, p. 22). From 2015 onwards, it unexpectedly pushed for greater energy access through grid expansion in SHS areas and also introduced a free OGS system, the safety-net programme TR-Kabikha (Cabraal et al., 2021, p.xxi; GoB, 2016, p. 120; Hossain et al., 2021). This free system has affected the continued viability of the SHS programme, as it led to a severe decline by interested parties to sign-up and take out loans to finance SHS (Ahmed et al., 2020; The Asian Age, 2018; IRENA, 2018, p. 20). Further, 1.2 million customers who had already committed themselves to the three-year loan plan towards owning a SHS have since defaulted on their monthly loan payments, resulting in a cascade of debt being passed from the consumers to the POs to IDCOL (Hossain et al., 2021) (Figure 2).

Adjusting policy to chart a path forward

Energy infrastructure requires long-term planning, and in most rural areas unable to acquire grid-connection, the first step on the energy ladder is through an off-grid system (UNITE, n.d.; WB, 2018). Notionally, OGS systems play a crucial role in the electrification of these areas by introducing a gateway to unlocking latent demand and improving the viability of larger systems in the future (Bisaga & Parikh, 2018; IRENA, 2019). Moreover, evidence suggests that when compared with situations in which loans and partial subsidies have been provided for the acquisition of an OGS system, the free provision of these systems offers only limited incentives to obtain higher rates of solar electrification (Yadav et al., 2019). Households in Uttar Pradesh, India, that were offered a free

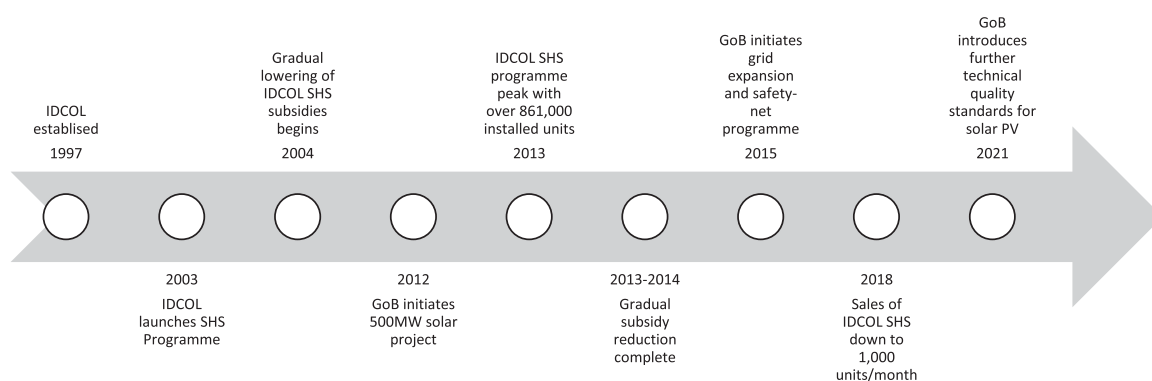


Figure 2. Timeline showcasing key events between the establishment of IDCOL and the recent introduction of new technical quality standards for solar PV by the GoB (Author's own).

system under a government-funded scheme, were less inclined to upgrade to larger solar systems, thus inhibiting the future progression on the energy ladder and limiting market development (*ibid.*). This objective of progression is not currently part of the design of the GoB programmes offering free OGS systems. If upgrades from the lowest energy levels to higher levels are not embedded in the OGS programme design, they are not likely to materialize on their own (WB, 2018).

Poor technical quality of systems and service present another key set of deterrents in the adoption of OGS systems in rural communities. This issue has recently been recognised by the GoB in its comprehensive technical quality standards for the solar PV sector as set out in the Energy Roadmap 2021–2041 (SREDA, 2021). Effective implementation of these standards would ensure that OGS system providers guarantee sound quality systems and services from the outset throughout the system's life cycle, including maintenance, battery replacement and other after-sales services for years to come (Hossain et al., 2021; Newcombe & Ackom, 2017; Sanyal et al., 2016; Yadav et al., 2019). As the experience so far has shown, system upkeep becomes cumbersome otherwise, denting customer confidence in the technical quality of the systems and leading them to default on their loan payments or stop using the systems altogether (Newcombe & Ackom, 2017; Saim & Khan, 2021). Government infrastructure planning for renewable energy has to therefore consider the need for sustained, long-term institutional support as a key aspect of off-grid electrification programmes (Rahman & Ahmad, 2013; Yadav et al., 2019).

Conclusion

For years, the Bangladesh SHS programme was a roaring success. For more than a decade after its inception in 2003, it thrived in an unprecedented manner, benefitting rural consumers and POs through its effective use of a PPP microcredit-based delivery mechanism. In this period of rapid market growth and success, end-users committed themselves to the project, maintaining impeccable payment records. At its height in 2013, more than 861,000 OGS units were installed, far above the programme's original target of 50,000 units over a period of five years.

Market difficulties began emerging from 2015 onwards. The GoB's sudden and unexpected decision to expand grid access into SHS areas and introduce free solar energy systems in addition to gradually declining programme subsidies led customers to turn their backs on SHS and default on their loan payments. In 2018, sales were down to only 1,000 units a month and, currently, 1.2 million customers who had already committed themselves to the three-year loan plan towards owning a SHS have not been repaying their loans, resulting in a cascade of debt affecting end-users, POs and IDCOL. The entry of unregulated sub-standard panels into the market has further resulted in a lack of confidence and distrust in the SHS by end-users.

The decline of the SHS programme provides key lessons for energy policy planning, including the need for improved coordination between various on- and off-grid interventions and regulatory oversight to ensure solar systems adhere to high-quality technical standards. The provision of free solar systems in particular has yet to prove its utility for transitioning from lower to higher energy levels and long-term end-user commitments to ensuring such access, key requirements for achieving SDG 7 in Bangladesh.

Note

1. These include the German Agency for International Cooperation (GIZ), KfW (Kreditanstalt für Wiederaufbau/German Development Bank), Asian Development Bank (ADB), Inter-American Development Bank (IDB), The Global Partnership for Result-Based Approach (GPOBA), Japan International Cooperation Agency (JICA), United States Agency for International Development (USAID) and Department for International Development (DFID) (IDCOL, *n.d.*; IDCOL, 2018; Cabraal et al., 2021, p. 15; Sharif & Mithila, 2013).

Disclosure statement

No potential conflict of interest was reported by the author(s).

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APPENDIX

Current and Previous POs

Grameen Shakti (non-profit organization), Rural Services Foundation, Bright Green Energy Foundation, Solar-En-Foundation, Resource Development Foundation, Srizon Bangladesh, AVA Development Society, Patakuri Society, Integrated Development Foundation, Upakulio Biddutayan O Mohila Unnayan Samity, Rimso Foundation, Thengamara Mahila Shabuj, Shangha, Panna Rural Development Foundation, RISDA Bangladesh, Shakti Foundation for Disadvantaged Women, Saif Powertec Limited, Palli Daridro Bimochon Foundation, DESHA Shechsashebi Artho-Shamajik UnnayanO Manobik Kallyan Sangstha, Bengal Renewable Energy Limited, Rural Energy Development Initiative, Bangladesh Rural Integrated Development for Grub-Street Economy, Network for Universal Services and Rural Advancement, InGen Technology Ltd., Green Housing & Energy Limited, Samaj Unnayan Palli Sangstha, Padakhep Manabik Unnayan Kendra, Jagaroni Chakra Foundation, Shubashati, SunRim Energy Limited, Sun Home Energy Limited, HAMKO Corporation Limited, Centre for Mass Education in Science, Association for Development Activity of Manifold Social Work, Pally Bikash Kendra, Sancred Welfare Foundation, United Development Initiatives for Programmed Actions, Al-Falah Aam Unnayan Sangstha, Clean Energy Foundation, Rural Development Sangstha, Atmabiswas Souro Shakti Limited, Polli Shakti Foundation, MAKS Renewable Energy Company Limited, Page Development Center, Frtends in Village Development Bangladesh, Hilful Fuzul Samaj Kallan Sangstha, COAST Trust, SKS Foundation, WAVE Foundation, Centre for Development Innovation & Practices, National Development Programme, ECOSocial Development Organization, Voluntary Organization for Social Development, Uttara Development Program Society, Venus International Co. Ltd., Gram Unnayan Karma, Southern Renewable Energy Ltd., Friendship, Enargio Bangladesh Ltd., Expert Renewable Energy & Engineering Ltd., Pacific Solar & Renewable Energy Limited, BAES Solar Limited, Australia Bangladesh Solar Power Dhaka Limited, Salek Solar Power Limited, Allied Solar Energy Limited, Punnyo Power Solution Ltd., Sustain (IDCOL, 2021).