SMART VILLAGES
New thinking for off-grid communities worldwide

Smart Villages in Bangladesh: Dhaka Workshop Report

Workshop Report 8

DHAKA, BANGLADESH

August 2015

Key words:
Energy Access, Rural Energy, Biomass, Pico-lighting Systems, Entrepreneurship

Smart Villages

We aim to provide policymakers, donors, and development agencies concerned with rural energy access with new insights on the real barriers to energy access in villages in developing countries—technological, financial and political—and how they can be overcome. We have chosen to focus on remote off-grid villages, where local solutions (home- or institution-based systems and mini-grids) are both more realistic and cheaper than national grid extension. Our concern is to ensure that energy access results in development and the creation of 'smart villages' in which many of the benefits of life in modern societies are available to rural communities.

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Summary

The Smart Villages Initiative continued its engagement in South Asia with a workshop held in Dhaka, Bangladesh on 26 August 2015. The aim of the workshop was to learn from Bangladesh's experience in providing energy to off-grid rural communities through home-based electricity systems, in particular solar home systems (SHS), and solar/solar-hybrid mini-grids. The workshop also focused on the role of these off-grid solutions to stimulate livelihood generation.

Participants in the workshop were informed about the work of the Infrastructure Development Company Limited (IDCOL), a government-owned financial institution under the Ministry of Finance, which continues to play a central role in promoting private sector financing in the infrastructure and renewable energy sector. Funding for the company comes from a number of stakeholders including the Government of Bangladesh and international donors. IDCOL works with partner organisations that are involved in the sale, installation, and maintenance of solar home systems. The company has also supported the installation of solar mini-grids for remote off-grid communities in the country.

Bangladesh has one of the highest rates of installation of solar home systems in the world, however, there are a number of challenges to the continued sustainability of these systems in the country, including: developing a competitive low-cost solar home system manufacturing industry locally to reduce dependence on imports, developing and ensuring quality standards for these systems, and creating more sustainable business models. For solar mini-grids, challenges that emerge from the discussion include continued government support for mini-grids in areas where there is no grid expansion planned for the foreseeable future, financial barriers, and affordable tariffs for rural consumers.

Despite the challenges, there are a number of opportunities to further develop the off-grid energy sector. Innovations like solar DC nano-grids can help the development of a truly bottom-up electricity system that is controlled and operated by local communities. The productive use of electricity can be promoted in areas where there are solar mini-grids. This can have a positive impact on local income generation in these areas. There are also opportunities to develop alternate sources of power generation including through biogas systems that use locally available biomass.

Hasin Jahan, Country Director, Practical Action, Bangladesh delivers her welcome address

1. Introduction

The Smart Villages Initiative continued its engagement in South Asia with a workshop held in Dhaka, Bangladesh on 26 August 2015. The workshop focused on the substantial experience in Bangladesh of off-grid rural energy systems, especially solar home systems. The workshop also looked at opportunities and challenges in deploying solar/solar-hybrid mini-grids in the country and at initiatives to develop the productive use of energy in these areas. The workshop was successful in its aim to identify some key lessons that can inform the Smart Villages Initiative's ongoing engagement programme in South Asia and in other regions.

A cross-section of stakeholders active in the Bangladesh off-grid energy sector—more than 70 people—participated in the workshop, resulting in animated and fruitful discussions. This report summarises key points arising from the presentations and discussions. Copies of the presentations are available on the Smart Villages website (www.e4sv.org). A background paper was prepared by Practical Action for the workshop summarising key aspects of the energy situation in Bangladesh. This can also be accessed on the website.

Annexes 1 and 2 of the report provide the workshop agenda and the list of participants along with their organisational affiliations.

2. Workshop Proceedings

Welcome

Hasin Jahan, Practical Action Bangladesh

The Country Director of Practical Action Bangladesh, Hasin Jahan, opened the workshop by welcoming participants and by introducing the work of Practical Action in Bangladesh. Practical Action's current activities in the energy field in Bangladesh include the Gaibhanda biogas from waste project and the development of biogas-fuelled irrigation pumps[1].

Hasin Jahan explained that the workshop had been developed collaboratively by the Smart Villages Initiative and Practical Action and is intended to inform policy makers and other stakeholders in off-grid energy in South Asia and other regions of the experiences and lessons learned in the off-grid energy sector in Bangladesh. The Poor People's Energy Outlook is Practical Action's flagship publication in the energy arena and has a similar aim to inform policymakers: the next edition will focus on Bangladesh along with two other countries.

In conclusion, she highlighted that Bangladesh is a country of rivers and sunshine but is presently unable to make full use of these renewable resources. She called on workshop participants to consider how they could be utilised to meet the energy needs of rural populations in Bangladesh and welcomed the development of policy recommendations as a result of the workshop.

1 For more details on these projects see bit.ly/1O96ZRw for the Gaibhanda project, and bit.ly/1jdlx5J for the biogas-fuelled irrigation pumps.

Opening address

Tapos Kumar Roy, Sustainable and Renewable Energy Development Authority

Tapos Kumar Roy chairs the Sustainable and Renewable Energy Development Authority (SREDA) in Bangladesh. He pointed to the partnership between Practical Action and SREDA, which began with preliminary discussions several years ago and is now taking effect through collaboration on the Poor People's Energy Outlook. He welcomed the concept of the "smart village" as a stimulus for innovation and new thinking and suggested that consideration should be given to how it fits with current rural development initiatives in Bangladesh.

Bangladesh, whilst experiencing urbanisation, is still a country dominated by the village as a unit. Various models are being used in Bangladesh to stimulate rural development. These currently include piloting new housing systems in 10 villages in which all required services are provided. Tapos Kumar Roy cautioned that, while appropriate, holistic approaches may bring new challenges, particularly in respect of organisation, compared to single issue interventions. He concluded by wishing success to the workshop in generating new thoughts on how to address these challenging issues of rural energy access in the future.

The Smart Villages Initiative

John Holmes, University of Oxford

John Holmes outlined the rationale behind the Smart Villages Initiative and introduced the concept of "smart villages" as a rural analogue to smart cities. In smart villages, energy acts as a catalyst enabling the provision of key services such as health, education and clean water and sanitation. Energy supports the establishment of new rural enterprises, which bring additional income into the village and consequently enable progression up the energy and development ladders.

The Smart Villages Initiative is undertaking programmes of engagement with frontline actors in six regions in Asia, Africa, and Latin America to identify the barriers to the provision of village level energy services for development and how those barriers can be overcome. The workshop in Bangladesh is part of a programme of activities in South Asia that will conclude with a final workshop to draw lessons together, scheduled to be held in Delhi in Spring 2016.

John Holmes summarised the findings of the work undertaken so far, which has confirmed the importance of taking an integrated approach and has identified a number of specific actions that can be taken by governments, development agencies and other stakeholders to accelerate

Tapos Kumar Roy, Sustainable and Renewable Energy Development Authority

progress towards ensuring energy access in rural communities.

In the ensuing plenary discussion, John Holmes highlighted how the Smart Villages Initiative focuses on a bottom-up approach that synthesises and communicates to policy makers the experiences of practitioners and communities working on the frontline of energy access for off-grid rural villages. In many instances, policymakers and multilateral agencies are not sufficiently aware of the practical realities on the ground. John Holmes agreed with the observation of workshop participants that drafters of national energy policies need to outline how these policies will benefit the poorest and most marginalized sections of society.

Village level energy access in Bangladesh, solar home systems and solar mini-grid

Farzana Rahman and Md. Mahfuzur Rahman, Infrastructure Development Company Ltd

IDCOL is a government-owned financial institution dedicated to promoting private sector financing in infrastructure and renewable energy. It is funded by the Bangladesh Government and a number of international development partners. Farzana Rahman's and Md. Mahfuzur Rahman's presentation described its approach to supporting solar home systems and mini-grids in Bangladesh.

IDCOL has supported the installation of 3.74 million solar home systems in Bangladesh to date, benefiting 17 million people and reflecting an installed capacity of 145 MW. The scheme has led to the employment of 75,000 people and has required an investment of US$600 million by IDCOL. The company expects to meet its 2018 target of 6 million solar home systems. The most commonly deployed solar home systems generate 40 to 50 W which can support four lamps, a phone charger, and possibly a TV or fan for 4–5 hours each night. 20, 50, and 85 W systems retail for US$170, $400 and $600 respectively.

IDCOL works through 56 partner organisations who sell, install and maintain the solar home systems. Each partner organisation (which may be an NGO or private sector organisation) is approved by a selection committee. IDCOL has a Technical Standards Committee that quality assures the products licensed for use under its schemes. Grants to households (for example, US$20 towards the US$ 170 cost of a 20W solar home system) are disbursed by the partner organisations. Customers make a down payment of 15% of the discounted cost of the system (i.e., the net price after the grant) and then receive a loan for the balance that they must pay off over a three-year period at an annual interest rate of 16%. IDCOL provides refinancing to its partner organisations at interest rates of 6–9% with loan periods ranging from 5–7 years, which means that they can recycle the loan money through several sets of customers.

Technical support is provided in the form of a call centre accessible to households (a sticker with the phone number is included on every system). A key to success has been the ownership of the scheme by stakeholders. IDCOL aims for the solar home system programme to become fully commercial and to this end, IDCOL is gradually withdrawing financial support by reducing the levels of grants and refinancing.

IDCOL is also supporting the installation of solar mini-grids for rural communities: 16 projects have been approved of which four (ranging in size from 100 to 141 kW) are already in operation. The target is 50 projects by 2017. IDCOL works with project sponsors whose responsibility is to select the areas and target customers, install and operate the mini-grid, supply electricity to

customers at an affordable rate, and collect monthly payments. IDCOL's role is to provide technical, project development, and financial support, to monitor performance, and to provide quality assurance. Project sponsors provide 20% of the capital cost as equity; IDCOL provides a loan of 30% as debt (at 6% per annum over 10 years), and a grant of 50% of the capital cost of the system.

In the discussion prompted by the presentation, participants proposed that biogas for power generation is important and that there should be more focus on it in Bangladesh. In response, Farzana Rahman indicated that IDCOL is considering several new technologies for future mini-grids. Although it is early days, the four operational mini-grids have been monitored on a monthly basis since the start of 2015. The results so far have been encouraging with production and sales of electricity matching targets. Customers are satisfied with services, and payment rates for electricity supplies are good.

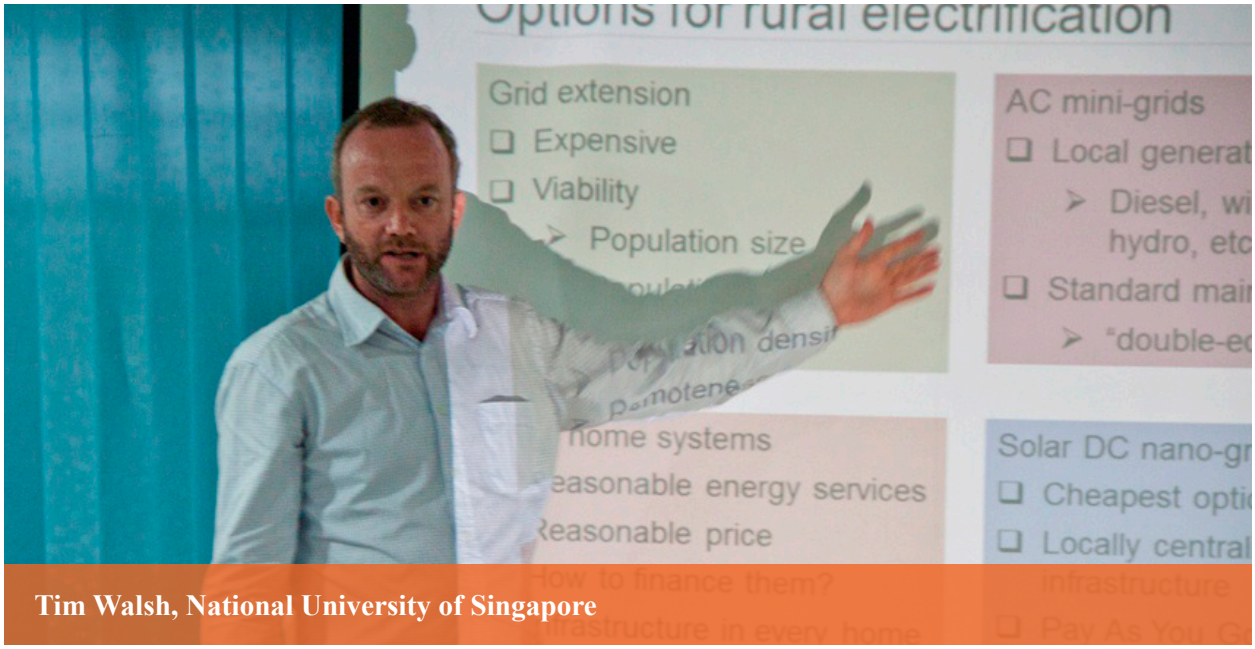
It was suggested that IDCOL could do more to promote productive enterprises enabled by access to electricity. IDCOL is considering a basic solar home system for very poor people: it is a plug and play system supporting two lights and a mobile phone charger and costing 5000—7000 taka (around US$64–90).

Solar DC nano-grids: A smart energy solution for villages

Tim Walsh, National University of Singapore

The DC nano-grid concept being developed by Tim Walsh and the team at the Solar Energy Research Institute of the National University of Singapore makes use of a solar panel and DC distribution network (working at 48V that is touch safe) to supply a cluster of 10 to 30 households. Solar DC nano-grids occupy a niche for villages of a certain size where they are the most cost-effective option. They are managed by a local engineer and guarantee a minimum level of electricity access to households. The concept is being piloted in Bangladesh in a project supported by GIZ. It currently has 10 connected households and the intention is to enlarge it to 30 households.

DC nano-grids offer greater flexibility than individual solar home systems and can achieve better than grid service levels at much lower cost. They make use of smart meters



Tim Walsh, National University of Singapore

and third-wire communication, and variable tariffs respond to the total energy in the grid. A variable charging regime is used with different costs per kilowatt-hour through the day to encourage a shift to daylight hours electricity use: the daytime tariff is half that of the night-time tariff. Once the batteries are fully charged an 'excess tariff' applies which is one quarter that of the normal tariff in order to encourage use of the available electricity.

Prepaid pricing plans start at 100 taka (US$1.3) per month. An electricity meter counts down the daily electricity quota based on the package purchased, which can be changed each month depending on circumstances. A key to success is the use of efficient DC domestic appliances (for example, LED bulbs at 2 to 5 W, fans at 4 W, and TVs at 6 W). As solar panels generate DC electricity, keeping the entire system and supported devices on DC avoids conversion losses. Village level nano-grids could form the basis of a bottom-up grid infrastructure.

In response to a question on costs, Tim Walsh indicated that by having one larger solar panel meeting the needs of several houses costs can be reduced compared to solar systems on individual households.

Solar mini-grids in Bangladesh: opportunities and challenges

Asma Huque, Prokaushali Sangsad Ltd

The 100kW solar mini-grid operating since 2010 on the remote island of Sandwip, Chittagong was constructed to demonstrate the use of solar energy for grid quality electricity and to increase access to electricity for commercial and productive use in an off-grid area. The project was financed by an IDCOL loan (30%), a grant from KfW (50%), and sponsor's equity (20%). Its cost was 56.78 million taka (around US$730,000). Distribution lines total 4 km.

Asma Huque indicated that target customers are primarily businesses and institutions rather than private households. Whilst the scheme has had a very beneficial impact on local businesses (for example, 198 commercial shops are connected, many of which have been opened since the initiation of the scheme), only two schools are connected as most cannot afford it. Many of the businesses previously generated their own electricity from small diesel generator sets. Fans are the biggest single load on the system.

The advantages of using solar panels as the main generation technology is that they are proven, can be installed quickly, have low operation and maintenance costs, and insulate the community from the fluctuating price of fossil fuels (although the system is a hybrid so still uses some diesel). Initially, the mini-grid did not make use of pre-payment meters as the technology was too expensive; however, now that their cost has reduced, these meters have been installed and are allowing timely cost recovery.

An unexpected challenge for the mini-grid has been the arrival of national grid electricity on the island. Other challenges include the difficulty of matching loads and the low income of households on the island, requiring the focus on commercial and institutional customers to achieve project viability. Operational challenges include the need for continuous support to ensure the smooth running of the plant, a lack of technical and administrative human resources on the island, the need for consumer education to optimise use, and the requirement for demand side management to achieve long-term reliable operation. Low-cost funding has been needed with long tenure, which is not typically available from commercial banks.

Workshop participants in discussion

A study on the electrochemistry of the Patharkuchi leaf (PKL) solar cell

Md. Kamrul Alam Khan, Jagannath University

Kamrul Alam Khan talked about a research project to generate electricity from the Patharkuchi leaf (PKL). A zinc-based fertiliser and hydrogen may be produced as side products. The Patharkuchi plant is fast-growing, and has leaves which are rich in chlorine and iron and contain a high proportion of water.

The PKL cell uses the juice from the Patharkuchi plant together with a copper sulphate solution as the electrolytes, and uses zinc and copper plates for the anode and cathode, respectively. The PKL cell is environmentally friendly and has the potential to contribute to electricity services in rural communities.

Create a network. Share electricity. Brighten the future.

Sebastian Groh, !SOLshare Ltd.

Bangladesh is the global leader in the number of installed solar home systems with almost four million such systems operating across the country. Sebastian Groh from !SOLshare Ltd. pointed out that there is a long history of utilising solar energy in Bangladesh with important contributions made by organisations such as Grameen Power (Shakti) and Microenergy International. The market for solar home systems is of considerable interest to investors, with companies like Rahimafrooz entering the market in recent years.

There are also substantial challenges for the continued growth of the solar home systems (SHS) market in Bangladesh. These are:

- Monthly installment payments are too high.
- Energy demand growth pattern is difficult to predict.
- All major partner organisations of IDCOL recover low levels of revenue.

Consequently, there has been a massive growth in the non-IDCOL SHS market (where there are problems of product quality), and bottom-up sharing patterns are already emerging.

Talking about the productive use of energy in off-grid areas, Sebastian Groh observed that it requires larger electrical loads. These higher loads could be generated by deploying mini-grids; however, the development of mini-grids is hampered by the high cost of capital.

Sebastian Groh then moved on to discussing innovations that are designed for bottom-up implementation. Examples of such innovations include retro-fitting containers to allow energy sharing and the increasing use of BKash, a mobile phone payment system. He elaborated on the innovations undertaken by !SOLshare in creating a DC mini-grid by interconnecting households, reducing the need for a central grid. Sebastian Groh also pointed out that many of the solar home systems currently being imported from China are of a lower quality and !SOLshare is interested in introducing a certification and guarantee programme that promotes high quality products.

The role of domestic energy access in enabling improved livelihoods

Louise Waters, Practical Action Consulting

The presentation delivered by Louise Waters sought to answer the question: "How (and when) does domestic energy access enable improved livelihoods?" She began by elaborating on some of the causal chains linking domestic energy access to livelihood outcomes. Seven channels were identified through which this happens: energy access can generate improvements in health and education, provide access to ICT, save time, and enable new and improved domestic productive activities. Furthermore, the provision of domestic energy access in a community or region can cause livelihood benefits through job creation in the energy access industry. Finally, the availability of modern energy for households can encourage skilled people like teachers to live in rural areas.

Development practitioners often expect that by providing improved energy access, they will see positive results on livelihoods through some or all of these mechanisms. However, research has shown that whilst sometimes there is a strong correlation between improved energy access and improved livelihoods, in other cases no such correlation can be observed.

A number of possible explanations for the failure of those mechanisms outlined to deliver the desired benefits were proposed. These took the form of barriers or blockages to specific parts of the causal chain. Many of these barriers originate from problems in the enabling environment: lack of job opportunities, unaffordability of appliances, shortages of raw materials, unequal accrual of benefits across society, or the lack of a market for energy-enabled goods and services. The eight attributes of energy access itself can also be enablers or barriers: capacity, affordability, duration, reliability, legality, convenience, quality, health and safety. To address these barriers, it was advised that developers of energy access programmes should consider linking with other development programmes to better ensure that all the enabling conditions are in place for people to make full use of the livelihood-enhancing opportunities of energy access.

What is a market map?

Louise Waters, Practical Action Consulting

Before the breakout sessions, Louise Waters presented the market mapping methodology developed by Practical Action that provided the basis of discussion and stimulus for ideas. The market map is a visualisation tool that helps in two main ways:

- To better understand how a market system operates.
- To locate barriers that prevent that market system from successfully delivering the desired outcomes.

Level 1, the market chain or value chain, contains all of the actors who at some point own the product or service as it makes its journey to the end user. Level 2 contains the inputs, services and finance that are required by the organisations in the value chain. Level 3, the enabling environment, contains the factors that exist beyond the market system but nevertheless have an important impact on the actors and processes in it: these include political and regulatory factors, financial and economic factors, and social and cultural factors.

The market map would provide a framework for systematically considering each feature of the market systems through which solar home systems and solar mini-grids deliver electricity access to off-grid consumers in Bangladesh.

After the presentation the participants divided into two groups to deliberate further on the off-grid energy market systems in Bangladesh and their impact on livelihoods. One group discussed 'Solar home systems in transforming livelihoods in off-grid rural areas', the other 'Rural electricity access provision in Bangladesh for transforming livelihoods (mini-grids)'. Utilising the market mapping tool to guide discussion, a lively debate was generated among the participants.

Louise Waters prepares the market mapping methodology

Breakout Group 1: Solar home systems in transforming livelihoods in off-grid rural areas

The first group deliberated on the role of solar home systems in transforming livelihoods in off-grid rural areas. Dr. Saiful Haque started the discussion by reminding the group of the set of questions for discussion that had been provided by Louise Waters in her presentation.

Talking about the role of IDCOL as a market facilitator, participants by pointed out that all the components of the solar home systems, apart from the solar PV panels, are being manufactured domestically within Bangladesh. Currently most of the solar PV panels are imported from China, Germany, or India and represent a major part of imports by the solar industry in Bangladesh. Local manufacturing costs are higher than those of products imported from China. The development of the local solar manufacturing industry has also been negatively affected by the lack of domestic testing facilities for battery quality.

The discussion of the nature of the market then turned to a distinction between the regulated and the unregulated market for solar panels and other components required in the industry. Participants observed that there was a major difference in the nature of the warranty and the after sales service between the two segments of the market. This segmentation of the market by quality has led to a challenge for consumers who do not understand quality differences between the products available.

The role of SREDA as the main regulator of the renewable energy sectors was also discussed. Participants indicated that SREDA should not be required to have a regulated procedure that excludes the non-regulated/lower quality segment but that they should instead provide and implement quality standards. Household consumers could make more well-informed choices based on the additional information that suppliers would be required to provide. These regulations have to be accompanied by public-outreach and information programmes that sensitise consumers to the importance of buying high-quality solar home systems.

Predatory pricing in the SHS market has emerged as a serious issue in the market. Further analysis is also required on the pricing of solar home systems based on their quality. It was also suggested that the cost of maintenance and servicing should be explicitly stated for all grades of goods.

The discussion then moved to a consideration of the types of batteries used in solar home systems. With improvements in battery technology, there needs to be a move away from lead-acid batteries to better quality products. Some participants felt that there was a need to keep low-cost products in the SHS market as consumers did not have the financial ability to buy the higher-end products. A code for renewable energy should be developed by SREDA. Some participants felt that rather than regulation, the focus should be on reducing the cost of production, as products manufactured in Bangladesh were 30% more expensive than Indian or Chinese ones.

Participants expressed concern about the high turnover of human capital in the solar home systems sector, which has a negative impact on operations and maintenance of the systems. The quality of available skill sets also remains a problem. Low-end skills are available in the market, but there is an acute shortage of higher-end skills in the labour force. Existing players in the microfinance market were not interested in increasing funding for skill upgrading and training. The case of BRAC and its involvement in the solar home systems market came under

discussion. Although BRAC is a large microfinance provider it has found it hard to breakeven in the SHS sector.

In relation to the environmental sustainability of the sector, the government's policy focuses on "reduce, reuse, recycle". Regarding financial sustainability, there was deliberation on whether subsidy was the best way to support the system. Participants stressed that subsidies should not be part of industrial policy promoting the domestic manufacturing of solar panels and should be restricted to the government's attempt to ensure poverty reduction. There was agreement that the introduction of subsidies had been detrimental to ensuring the sustainability of production and sales in the SHS sector. A consensus emerged that there should be a diversification of the renewable energy sector beyond solar home systems, to make it more economically viable. This can help in moving away from a subsidy-based model towards a more sustainable commercial business model.

Regarding the role of finance and the appropriate cost of capital, participants agreed that that if microfinance institutions are involved in providing loans for solar home systems, they should do so in a relationship with IDCOL. This would ensure access to subsidised lending rates across the value chain. Customers who get 1–3 year loans and SMEs who get 3–5 year loans will be able to pay off their debt at interest rates of 6-9%.

Participants also discussed consumer habits and the socio-economic perceptions of potential customers. It was suggested that a sound business model for solar home systems will require an examination and analysis of the entire supply chain. There should be standards for all components and the import duties on batteries should be capped at 80 percent of the cost of the batteries. There was a suggestion that diversifying sourcing strategies could help reduce the cost of photovoltaic (PV) panels but others felt that the focus should be on first improving the performance of domestic producers.

Participants discuss consumer behaviour during a breakout session

The conclusion was that the government should improve its feed-in-tariff policy and should allow a move from SHS to mini-grid technologies. It was also necessary for the government to work with financial players to improve pay as you go schemes.

Breakout Group 2: Rural electricity access provision in Bangladesh for transforming livelihoods (mini-grids)

The second breakout group addressed the issue of rural electricity access provision in Bangladesh for transforming livelihoods, with a particular emphasis on the role of solar and solar-hybrid mini-grids.

The discussion began with an animated summary of the political economy of rural electrification. A point was made that as per Article 16 of the constitution, the government is committed to providing electricity to Bangladesh's rural population but, in reality, providing rural electricity is seen by politicians as a means of gaining support from rural voters. Participants pointed out that mini-grids are relatively unknown and misunderstood by both politicians and rural voters. This means that a politician who backs a mini-grid development is unlikely to garner as many votes as one who champions grid extension. To rectify this disparity, participants proposed that the government officially recognise mini-grids as a generation technology on a par with grid-electricity.

The discussion proceeded to evaluating where mini-grids would be most effectively deployed in Bangladesh. There was a general consensus by participants that mini-grids are not able to compete with grid extension on an economic basis for most rural areas in Bangladesh due to the country's relatively small size and the ability for relatively cheap grid extension. Instead, participants suggested that efforts to deploy mini-grids be focused on Bangladesh's islands—locations where the grid is unlikely to reach in the next 20–50 years.

Technological barriers to mini-grids were highlighted by participants. In particular, the importance of establishing the appropriate size of the system was stressed. To address this, participants' emphasised the need for detailed stakeholder surveys before building mini-grids, although it remained unclear how to address the issue of dynamic changes to end-user demand for energy. Further technical issues discussed included the need to manage loads efficiently and to ensure the use of energy efficient appliances. The need for a comprehensive maintenance and operations protocol was brought up. Participants remained divided on whether operation and maintenance services should be provided by the public or private sector.

When prompted on the pros and cons of AC and DC mini-grids, participants expressed concern over DC mini-grids due to the entrenched ecosystem of AC consumer goods and were unconvinced that a suite of DC consumer goods would be developed. In this case, DC mini-grids would effectively lock rural households into the wrong technology.

Financial barriers were identified as the major constraint to greater involvement of the private sector in mini-grids development and operation in Bangladesh. Specifically, participants highlighted that currently there are no safeguards guaranteeing a return on investment. These safeguards need to be robust to the political cycle and ensure that private sector investors are able to receive a reasonable rate of return. An adapted feed-in-tariff solution was agreed to be the most effective policy tool to ensure financial sustainability. Participants highlighted the high initial capital costs for mini-grids as another barrier. The solution proposed by participants was to increase international funding in research and development to bring down capital costs.

The last topic discussed in the breakout session focused on end-users, in particular how to ensure that end-users are able to afford mini-grid electricity tariffs. It was acknowledged that mini-grid tariffs in general and in Bangladesh are significantly more expensive than comparable electricity services from the grid. Participants strongly advocated for the government to survey end-users' ability to pay and to step in and cover the difference in tariffs.

Plenary discussion

The plenary discussion focused on two important issues: recycling batteries from solar home systems and the potential of biogas systems to provide electricity.

On the question of how to dispose of the batteries associated with almost four million solar home systems installed across Bangladesh, participants explained that there is a buy-back mechanism for batteries in place in the country. Under this mechanism IDCOL is mandated to buy-back batteries from end-users after five years. End-users are remunerated for the lead-paste contained in the batteries at a rate of 28% of the current market value of the equivalent battery. Although the system is well-designed, it is hindered by a lack of recycling capacity. The discussion concluded with participants asking whether the market mechanism is able to provide appropriate incentives for private sector actors to enter and undertake recycling of batteries.

Flowing on from the discussion of recycling batteries, a point was made concerning the type of battery used. The use of nickel batteries was proposed as a potential alternative to currently used technologies in SHS due to their relative simplicity. The Solar Energy Research Institute at the National University of Singapore, is currently undertaking research on the pros and cons of using nickel batteries for solar home systems.

The second topic discussed in the plenary session focused on the potential of biogas to provide electricity to rural households. It was noted that researchers in Bangladesh are working on small-scale biogas systems (between 1.6m^3 to 2.4m^3) that are able to supply a family's cooking needs from the waste of one cow or 100 chickens, in addition to human and kitchen waste. A recently developed biogas system called BioSocket that primarily supports cooking is also capable of generating a few watts of power and is an emerging technology. The discussion concluded with participants expressing their interest in better understanding the potential of a hybrid solar-home system and household-scale biogas gasifier as an integrated system for Bangladeshi rural households.

3. Summary and Closing remarks

John Holmes, co-leader of the Smart Villages Initiative, closed the plenary session by summarising the workshop. He appreciated the active participation of the attendees and the lively and fruitful discussion that resulted. This workshop marked the start of the Smart Villages Initiative's engagement in Bangladesh, and he hoped that it will serve as the base for collaborative follow-up activities with workshop participants. The workshop helped researchers at the Smart Villages Initiative learn a number of lessons from the solar home systems experience in Bangladesh that can be taken to other regions and countries. Although Bangladesh is the leading nation for solar home system penetration globally it is apparent that there are a number of challenges being faced by the sector. These challenges include saturation of the solar home system market and difficulties in retracting subsidies. These are pressing challenges that must be addressed by all stakeholders. The Smart Villages Initiative will play its role as a unique platform for bringing together an objective front-line view of the solar home system market and communicating findings and recommendations to national and international policy makers.

"The Smart Villages Initiative learned a number of lessons from the solar home systems experience in Bangladesh that can be taken to other regions and countries

Abdur Rob, Team Leader of the Food, Agriculture, and Markets Programme at Practical Action, Bangladesh closed the workshop. Abdur Rob expressed his views on the Smart Villages Initiative and its unique position as a mediating platform that can help catalyse access to modern energy and rural development in Bangladesh. He thanked all participants and the Practical Action team for organising the workshop.

Annex 1: Workshop Programme

Wednesday, 26 August

1000 **Welcome speech**

Hasin Jahan, Country Director, Practical Action, Bangladesh

1010 **Opening address**

Tapos Kumar Roy, Additional Secretary and Chairman, Sustainable and Renewable Energy Development Authority (SREDA)

1020 **The Smart Villages Initiative**

Dr. John Holmes, Senior Research Fellow, University of Oxford

1100 **Break**

1115 **Village level energy access in Bangladesh, solar home systems and solar mini-grid**

Farzana Rahman, Unit Head (Investment) and Md. Mahfuzur Rahman, Assistant Manager, Renewable Energy, IDCOL

1145 **Perspectives on solar home systems and solar mini grid in Bangladesh – Opportunities & challenges**

Dr. Tim Walsh, Solar Energy Research Institute of Singapore (SERIS), National University of Singapore (NUS). "Solar DC nano-grids: A smart energy solution for villages"

Asma Huque, Managing Director, Prokaushali Sangsad Limited. "Solar mini-grids in Bangladesh – opportunities and challenges"

Dr. Md. Kamrul Alam Khan, Professor, Jagannath University. "A study on the electrochemistry of the Patharkuchi leaf (PKL) solar cell"

1230 **Lunch**

1330 **Create a network. Share electricity. Brighten the future.**

Sebastian Groh, !SOLshare Ltd.

1400 **The role of domestic energy access in enabling improved livelihoods**

Louise Waters, Energy Consultant, Practical Action Consulting, UK

1430 **Breakout session: Rural electricity access provision in Bangladesh for transforming livelihoods**

Louise Waters, Energy Consultant, Practical Action Consulting, UK "What is a Market Map?"

Facilitators:
Dr. Saiful Huque, Director, Institute of Energy, University of Dhaka (SHS)
Uttam Kumar Saha, Head, Energy and Urban Services, Practical Action, (Mini Solar Grid)

1600 **Break**

1615 **Breakout groups report back to plenary**

1645 **Plenary discussion**

1715 **Summary**

Dr. John Holmes, Senior Research Fellow, University of Oxford

1730 **Summary and Closing remarks**

Abdur Rob, Head, Food, Agriculture and Markets Programme, Practical Action, Bangladesh

Annex 2: Workshop Participants

Name	Organisation
Hasin Jahan	Country Director, Practical Action, Bangladesh
Dr. Zaki Uz Zaman	Head of UNIDO Operations in Bangladesh, Dhaka
Shamsunnahar Begum	Director, Sancred Welfare Foundation, Sultanpur, Bangladesh
Asma Huque	Managing Director, Prokaushali Sangsad Limited, Dhaka
G.M. Anam Ahmed	Founder and Chief Executive, Jalalabad Foundation and Bangladesh Writers Forum
Md. Murshidur Rahman Khan	Executive Director, Sinnomul Mohila Samity, Gaibandha, Bangladesh
Md. Momtazul Islam	Executive Director, Al-Falah Aam Unnayan Sangstha (AFAUS), Dinajpur, Bangladesh
Kamrun Nahar Shahana	Executive Director, Bangladesh Human Rights and Resources Development Society, Dhaka
Ms. Rubana Nasrin	Chief Executive Officer, Green Tree, Dhaka
Mohammad Rafiqul Islam	National Project Director, Poverty, Environment and Climate Mainstreaming (PECM) Project, UNDP and UNEP, Dhaka
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Shah Zulfiqar Haider	Director (Energy Efficiency and Conservation), Sustainable and Renewable Energy Development Authority (SREDA), Power Division, Ministry of Power, Energy and Mineral Resources, Dhaka
Md. Shamsul Haque	Chairman, Biogas Technology Consulting Services Limited, Dhaka
Tapos Kumar Roy	Additional Secretary and Chairman, Sustainable and Renewable Energy Development Authority (SREDA)
Mohammed Khairul Islam	Deputy Executive Director, JCF
Siddique Zobair	Joint Secretary, Member (Energy Efficiency), Sustainable and Renewable Energy Development Authority (SREDA), Power Division, Ministry of Power, Energy and Mineral Resources, Dhaka
Dr. John Holmes	Co-Leader, Smart Villages Initiative
Dr. Terry van Gevelt	Research Associate and Affiliated Lecturer, Centre of Development Studies, University of Cambridge
Dr. Shailaja Fennell	University Lecturer, Centre of Development Studies, University of Cambridge
Dr. Timothy Walsh	Group Head, Off-Grid PV Systems, Solar Energy Research Institute of Singapore (SERIS), National University of Singapore (NUS)
Abdur Rob	Head, Food, Agriculture and Markets Programme, Practical Action, Bangladesh
Uttam Kumar Saha	Head, Energy and Urban Services, Practical Action, Bangladesh
Dr. Faruk-ul-Islam	Head of Policy, Practise and Programme Development, Practical Action, Bangladesh

A.Z.M. Nazmul Islam Chowdhury	Head of Extreme Poverty Programme, Practical Action, Bangladesh
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Farzana Rahman	Unit Head (Investment), Renewable Energy, IDCOL
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Mohammad Al Mamoon	Assistant Professor, Department of Chemistry, Jagannath University, Dhaka
Louise Waters	Energy Consultant, Practical Action UK
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Md. Mahfuzur Rahman	Assistant Manager, Renewable Energy, IDCOL
Ahmed Ali	Technology Promotion Officer, Practical Action, Bangladesh
Taif Hossain Rocky	Project Officer
Md. Kamrul Islam Bhuiyan	Senior Knowledge Officer Monitoring and Evaluation (M&E), Practical Action, Bangladesh
Makfie Farah	Senior Project Officer, Policy Advocacy, Practical Action, Bangladesh
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Goutam Chakraborty	Accounts-cum-Internal Auditor, Rural Development Sangstha, Sherpur, Bangladesh
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Shehabul Munir	Intern, Practical Action, Bangladesh

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