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COUNTRY REPORT AND CASE STUDY SUMMARIES – INDIA

DECENTRALIZED ENERGY PORTFOLIO REVIEW

DECEMBER 20, 2016

This publication was produced for review by the United States Agency for International Development. It was prepared by Management Systems International, a Tetra Tech Company, for the E3 Analytics and Evaluation Project.

COVER PHOTO

Caption: Women's self-help group poses with their group savings ledger as part of the Humana People to People activity in Adhouli Village, Uttar Pradesh, India.

Credit: Sam Hargadine, MSI

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DECENTRALIZED ENERGY PORTFOLIO REVIEW

Contracted under AID-OAA-M-13-00017

E3 Analytics and Evaluation Project

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ACRONYMS

Ah	Amp hour
CEEW	Council on Energy Environment and Water
CG	Credit Guarantee
CLEAN	Clean Energy Access Network
DCA	Development Credit Authority
DD	Direct Delivery
DDG	Decentralized Distributed Generation
DDUGJY	Deen Dayal Upadhaya Gram Jyoti Yojna
DE	Decentralized energy
DIV	Development Innovation Ventures
dTS	Development & Training Services, Inc.
E3	Bureau for Economic Growth, Education and Environment (USAID)
E&I	Office of Energy and Infrastructure (USAID/E3)
ES	Enterprise Support
HPPI	Humana People to People India
JNNSM	Jawaharlal Nehru National Solar Mission
KREDL	Karnataka Renewable Energy Development Ltd.
kWp	Kilowatt peak
LaBL	Light a Billion Lives
LED	Light-emitting diode
LPG	Liquefied petroleum gas
MGP	Mera Gao Power
MNRE	Ministry of New and Renewable Energy
MSI	Management Systems International, Inc.
NGO	Non-governmental organization
OPIC	Overseas Private Investment Corporation
PAYG	Pay as you go
PMU	Power Management Unit
PV	Photovoltaic
REMMP	Renewable Energy Microfinance and Microenterprise Program
SARI/E	South Asian Regional Initiative – Energy
SARI/EI	South Asia Regional Initiative for Energy Integration
SAST	Sakhi Arogya Samudaya Trust
SCALE	Sustainable Clean Access Livelihood Energy
SFCBA	Solar Finance Capacity Building Alliance
SELCO	SELCO Solar Light Pvt. Ltd.
SMF	Sealed maintenance free battery
SSK	Sakhi Samuday Khosh
SSP	Swayam Shikshan Prayog
SSEN	Sakhi Social Enterprise Network
STA	Sectoral Technical Assistance
SURE	Sakhi Unique Rural Enterprises
SVEP	Start up Village Entrepreneurship Program
TERI	The Energy and Resources Institute
TRP	Technical Resource Person/People
UP	Uttar Pradesh
UPNEDA	Uttar Pradesh New and Renewable Energy Development Agency
USAID	United States Agency for International Development

W	Watt
Wh	Watt-hour
Wp	Watt peak
W-Power	Women Entrepreneurship in Clean Energy

EXECUTIVE SUMMARY

Portfolio Review of USAID Decentralized Energy Activities

This document presents and compares five Indian case studies that inform a wider portfolio review of USAID decentralized energy (DE) investments began between 2004 and 2012. DE in this context refers to interventions supported by USAID that generate limited wattage, serve a small number of customers per system/installation, are off-grid, and utilize clean energy technologies. USAID DE investments take the form of sectoral technical assistance, credit guarantees, enterprise support, and direct delivery modalities. Examples of the technologies supported include solar powered micro-grids, household energy systems, micro-hydro generators, and biomass installations supported by a range of business models, financing mechanisms, public policy arrangements, and capacity-building assistance for system operations and maintenance.

The range of activities representing the entire USAID DE portfolio includes 31 unique investments in 12 countries, including 2 global credit guarantee facilities. Based on criteria developed collaboratively with USAID, three countries were selected for in-depth study: India, Brazil, and Tanzania. Therefore, primary data was collected for applicable DE investments in these 3 countries, which together represent 13 case studies.[1] In a separate Synthesis Report, these case studies – the 5 India cases of which are summarized in this document – along with a literature review, summary of related performance evaluations, and descriptive statistics relating to the entire 31-activity portfolio are used to answer the review's 3 research questions:

1) To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?
2) To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?
3) What decentralized energy implementation models and processes have been most effective at achieving sustainability, scale, or replication?

USAID DE Investment Modalities

Global USAID DE investments fall into four overarching categories, which are:

Credit Guarantees (CG): Through the Development Credit Authority (DCA), USAID uses partial credit guarantees to mobilize local financing, by covering 50 percent[2] of the principal in loans to projects that advance the Agency's development objectives. This risk-sharing mechanism encourages commercial banks and other lenders and creditors to expand credit to sectors and industries they currently do not serve, or to lend with less collateral than previously required. The expectation is that during the guarantee period, the lender will get to know the industries and associated risks so that in the future, the lender will have the confidence to issue comparable credit without enhancements.

Direct Delivery (DD): USAID activities or activity component(s) in which USAID or other donors invest the majority of the capital and other associated costs for repairing, procuring, and/or installing one

[1] Five in Brazil. Five in India. Three in Tanzania.

[2] The large majority of CG activities cover 50 percent of the loan principle; however, there are exceptions. For example, a loan portfolio guarantee to a Nigerian financial institution covered up to 80 percent for loans disbursed for renewable energy promotion.

or multiple DE systems. In addition to paying for capital costs, these projects may provide training, capacity building or other technical support for the installation and/or operation of the DE system.

Enterprise Support (ES): USAID grants made directly to clean energy enterprises to support testing and/or scaling of breakthrough technologies and solutions. This may include complementary technical assistance and training to the enterprise for such purposes as business acceleration, improved management, equipment sourcing, and increased access to financing. This category includes Development Innovation Ventures (DIV) grants and grants under contracts or larger umbrella mechanisms.

Sectoral Technical Assistance (STA): USAID project or project component(s) that strengthen the enabling environment for enhancing access to clean energy services in off-grid areas. This may include, for example, developing new policies, legislation, and/or regulations, strengthening relevant government agencies and higher education facilities, and training of financial institutions on off-grid clean energy lending.

DE in India

The Government of India has set ambitious goals for extending electricity access to all communities by 2020. The boldness of this plan is underscored by findings from the 2011 census, whereby 33 percent of Indian households lack access to a reliable energy source (approximately 400 million people). The vast majority of these households are in rural India. A combination of great distance, less dense populations, and lower ability to pay makes electrifying all of rural India using the central grid unlikely in the near-term. The government has identified over 20,000 villages where grid extension is cost prohibitive; and these are earmarked for electrification using DE sources. However, the scope for application of decentralized technologies is potentially much greater than that for two reasons. First, meeting the ambitious targets for extension of the grid system within the government's proposed timeframe will be challenging, and, in the meantime, decentralized technologies may play a role in providing electricity. Second, India's grid system has both insufficient generating capacity and distribution problems (poor infrastructure leading to high losses) that result in regular power cuts and power quality problems. These issues are particularly acute in rural India, where grid-connected households may only receive power for a few hours per day. Decentralized technologies provide an alternative source for households in the face of an unreliable grid system.

The magnitude of energy poverty in India requires scalable solutions to achieve the ambitious goals the government has set out. Thus commercial firms have entered the market to capitalize on the potential of recent DE-related technological advancements, such as cost-competitive solar photovoltaic (PV) systems and innovative financing and fee collection structures; pay-as-you-go household financing (see the case study on Simpa Networks); or group-oriented fee collection schemes (see the case study on Mera Gao Power). Further, DE solutions are also linked to women's empowerment and livelihood generation opportunities. An example of this is Swayam Shikshan Prayog's training of more than 1,000 women entrepreneurs in Maharashtra and Bihar. These entrepreneurs were trained in the use and basic maintenance of clean energy technologies and given business and entrepreneurial training in order to establish their own clean energy distribution businesses.

USAID DE Investments in India

India hosted 6 of the 31 activities that make up the review's inventory, making it the portfolio's most active host country. These are:

1. Mera Gao Power (MGP);
2. Humana People to People – India (HPPI);
3. W-Power/Swayam Shikshan Prayog (SSP);

4. South Asia Regional Initiative for Energy (SARI/E) – Phase 2;
5. SARI/E – Phase 3; and
6. Orb Energy Portable Credit Guarantee.

In addition, Simpa Networks, which received a DIV grant in 2013, was included as a case study for this country report due to its comparability with other ES activities in India and among the wider global portfolio.

Activities Selected as Cases

This report summarizes then compares five of the investments noted above. Cases were selected based on initial desk research and through a collaborative process with USAID, which is described in the report's Methodology section beginning on page 6.

Case Study 1 – MGP (ES): MGP received a USAID ES grant in 2011 as part of the Global Development Lab's DIV competition designed to support breakthrough, scalable solutions for intractable development challenges. DIV grant funding was provided to (1) build off previous pilot-testing and test the commercial viability of MGP's solar micro-grid technology and (2) assess the development impact of these micro-grids on the lives of customers. Activities were concentrated in Uttar Pradesh. MGP reports having reached 20,000 households across 1,073 villages with its micro-grid operation.

Conclusions: MGP operates an unsubsidized-driven business model and has witnessed rapid growth. MGP's success to date has been on account of its standardized micro-grid technology that caters to basic energy needs at an accessible price with prompt and hassle-free service. This service includes a customer service line that logs customer complaints and dispatches an MGP trained technician to address maintenance issues. MGP's fee collection approach has been effective; where a weekly fee is collected from community customer groups that hold individuals accountable. Another critical factor that has contributed to MGP's growth has been its focused operations within a limited geography, which has contributed to efficiencies in operations. The main threat to MGP's business model is from the arrival of the main grid into communities it is currently serving, but 100 percent household connectivity and reliable energy service provision through the main-grid appears unlikely in the medium term. A factor that will determine MGP's future growth is its ability to develop innovative solutions to meet the increasing aspiration levels of their customers.

Case Study 2 – HPPI (DD): From 2009 to 2011, HPPI utilized a grant investment from USAID and in-kind support from the Tata Energy Research Institute (TERI) to directly provide 100 solar lantern changing stations (with 60 lanterns each) for use in western Uttar Pradesh. The activity had a women's empowerment component that supported women's self-help groups. These groups were geared towards pooled savings plans that assisted women in times of personal shocks (e.g., a family health crisis), micro-investments (e.g., to start a commercial activity), and encouraged female entrepreneurs to start up solar lantern rental businesses to support the larger community's lighting access needs. Female entrepreneurs were provided the lanterns in-kind and were usually selected from within the existing self-help group structures. Lanterns were then rented out to community members for a fee (ranging from a per night basis in some communities to as long as a month).

Conclusions: At the time of the review team's visit in 2015, it was estimated that between 50 and 60 percent of the solar lanterns were still in working order, which given the typical life-span of similar products, was in line with expectations. There is no mechanism in place to replace the donated lanterns or continue servicing them to extend their already stretched lifespan. An indirect achievement was a noticeable increase in demand for solar products in the communities HPPI served, according to residents. "Saur Urja shops" are entering the market displaying a number of solar products with increasing sophistication. A concern for these shop keepers however is that their more expensive, higher-quality products, compete with cheap, low quality imported torches which are more accessible to the low-income communities that make up the bulk of the energy poor in western UP. The female entrepreneurs renting out the HPPI lanterns noted that their small-business ventures contributed to an increase in their household's income and increased their agency within the community. The review team concluded that HPPI's model was successful in empowering specific female entrepreneurs and the women's groups it works with; however, the technical products it provided are unlikely to be sustained or replaced in the long-term and its model is unlikely to scale due to its reliance on donor support.

Case Study 3 – SSP (STA): From 2012 to 2015, SSP received USAID grant support for the purpose of strengthening DE distribution pathways in Maharashtra and Bihar. These funds, which reflect an STA investment approach, were provided through the Partnership on Women's Entrepreneurship in Clean Energy (W-POWER) program in India. USAID funds were used to train female entrepreneurs to sell clean energy products through associated distribution schemes. To generate demand, efforts were made to promote clean energy generation technologies at the community level through promotional materials (e.g., extension efforts to rural market stalls, community group meetings, and wall murals), and the establishment of an "energy hub" where nearby residents could assess various products and speak with knowledgeable suppliers. The energy hub also served as the training space for the initiative's female entrepreneurs. At the end of the activity, 1,010 entrepreneurs were trained, selling solar lanterns to an estimated 40,000 households.

Conclusions: USAID support for SSP has only recently ended, making an assessment of sustainability provisional. This report speculates that while existing systems have been sustained, long-term funding systems are not in place to ensure the sustainability of the SSP entrepreneurial-training model, nor the long-term operations of the energy-hub. Social benefits of the program included an uptake in solar lamp usage to replace kerosene across in the communities entrepreneurs operated and, according to the entrepreneurs themselves, stronger household decision-making authority because of the income they were bringing into the home. Without continued donor support, it is unlikely that the SSP model will achieve scale beyond its current network.

Case Study 4 – Simpa (ES): Founded in 2010, Simpa Networks sells solar power through a process similar to mobile credit purchasing. In 2013 the firm obtained a USAID-DIV ES grant to test their model at scale. Specifically, the grant was designed to (1) rollout Simpa's model to 12,000 households mainly in Uttar Pradesh and (2) measure the social impact and financial viability of the approach in order to attract additional private investment. While the portfolio review's period of interest are USAID-investments that began between January 2004 and December 2012, Simpa's earlier sites were installed before the cutoff date, thus its inclusion in the overall portfolio. Further, Simpa has attracted an array of donor backed and commercial financing to support its scaling vision and provides instructive lessons for the wider-portfolio.

Conclusions: A major contributor to Simpa's success has been its ability to attract low-cost, long-term debt in order to finance its expansion plans and offer low usage fees to its customers. The nature of its fee collection scheme is innovative, using a pay-as-you-go model that allows energy poor households to access comparatively sophisticated solar home systems without the up-front costs that would be associated with purchasing a system on their own. This pay-as-you-go system with buyout options requires Simpa's continued engagement in the regular maintenance of its products (they continue to own the system), until the user is able/chooses to pay-off the system or return it. While Simpa has attracted an impressive degree of additional financing for its expansion, its plans for 10 percent month on month growth is ambitious. Simpa, like MGP, appears secure in the medium term but uncertainty with respect to public subsidies for solar home lighting systems that may compete with its unsubsidized models, along with uncertain grid-expansion plans, pose risks for the firm's long-term viability.

Case Study 5 – Orb Energy (CG): Orb Energy is a private limited enterprise selling distributed solar PV and solar thermal water heaters. In 2012 Orb obtained access to a portable loan guarantee backed by USAID's Development Credit Authority (DCA). Orb aimed to scale up its operations to establish 500 branches within 3 years (ending in 2016). Under this arrangement, Orb at the time of the review team's visit had obtained $1 million from Deutsche Bank with the support of the CG. This first tranche was for backward integration within its solar water heater vertical, i.e., towards setting up a manufacturing facility for solar water heaters with an eventual capacity of 1,500 systems per month, which would result in greater cost efficiencies and improved margins. This Bangalore-based facility was formally inaugurated in September 2015.

Conclusions: Orb has been unable to secure the second half of its CG backed ceiling towards similar backward integration within its solar PV business line. This was due to Deutsche Bank's internal criteria, which limited the bank's exposure to one-third of the net assets of a firm, i.e., for the bank to lend $2 million to Orb, the firm's net assets would need to be in excess of $6 million as opposed to Orb's current $4.9 million. Orb representatives told the review team that they hope for USAID's support in ongoing discussions with Deutsche Bank to relax the criteria, due to the risk sharing nature of the CG. While this report is unable to provide specific conclusions about Orb's sustainability or scaling model because of the uncertainty relating to Orb's ability to access additional credit using the CG, this uncertainty is itself instructive. DCA support can take multiple structures, i.e., a loan guarantee for a specific enterprise and specific lender, a portfolio guarantee for a number of loans provided by specific lender, or (as in this case) a portable guarantee that can be used by the holder (Orb) to "shop around" for lenders. Because CG-type support is demand-driven with respect to lenders, generalizable conclusions from this case are limited. Factors contributing to CG model successes are by their nature relationship, context, and demand specific.

Cross-Case Conclusions

Capital and Policy/Regulatory Uncertainty

Current Government of India policies for electricity access favor grid expansion and regulatory mechanisms provide insufficient guidance on the relationships between DE and grid-service. This raises a number of considerations for DE providers and customers, including:

- How the promise of grid-expansion may impact customer willingness to pay for DE solutions in the short-term;

- What happens to DE investments when grid-access arrives to communities currently not served; and
- How will public utilities integrate micro-grids, among other DE solutions, into the existing grid system?

Uncertainties surrounding these types of considerations pose risks to DE providers, especially commercial actors, and is a factor in decisions being made today both for seekers and providers of capital. Firms like MGP, with its micro-grid model, recovers costs in two to three years, which is a better financial bet than firms that would require capital in greater orders of magnitude to establish more sophisticated off-grid solutions. The greater up-front capital costs and longer terms of repayment exacerbate the risk felt by investors betting on DE initiatives. As seen in the Simpa case, access to large amounts of capital and long-term repayment plans allows the firm to provide pay-as-you-go services to those who would otherwise be unable to afford solar home systems. Clarifying these uncertainties would likely contribute to greater access to capital for firms that seek large-scale social change through commercial pathways.

Also relating to access to capital, repeated interviews with sectoral and case-level informants suggest that the Indian financial sector is largely unfamiliar with DE activities and credit underwriting for these types of investments have benefitted from donor funded grants. These grants, such as those sponsored by USAID-DIV, are instrumental in establishing the business framework and financial records needed to pursue private future sources of private financing. Sectoral informants credit USAID's support in building linkages between the financial sector, policy makers, and DE providers and welcome further assistance to solidify and expand progress. Points of further improvement include shifting credit underwriting for DE investments away from collateral-dominated analysis to cash-flow based reviews better suited to new firms in a new market-sector.

Commercial Pathways

Four-hundred million Indians without energy access is a development challenge that dwarfs the other countries represented in the wider USAID portfolio. Given India's sophisticated capital markets and stable political system, commercial DE firms and investors are well placed to compliment government efforts to massively extend access in the short and medium-term. NGO-driven cases (HPPI and SSP) appear unlikely to be sustained after donor assistance ends and unlikely to be scaled beyond their specific target communities. By contrast, the commercially oriented partners (MGP and Simpa) continue to expand after their grant periods of performance end; however, suggest that employee talent acquisition, access to capital, and the policy uncertainties described above may prove to be challenges to their success.

Gender Equality and Female Empowerment

The NGO-driven cases were designed to contribute to additional objectives beyond those concerned with energy access; most-prominently women's empowerment, and along these metrics HPPI and SSP have been largely successful. Both models trained female entrepreneurs to contribute to the solar lighting value chain (HPPI to rent solar lanterns and SSP across a range of products and distribution schemes) and respondents from both activities suggested that they have experienced increases in their personal agency in the home and in their communities. This is mainly due to the increased income these women are able to generate, but also their roles as a provider of a valuable service to communities that may not have access to other forms of lighting. None of the five-cases examined in this report linked specific female empowerment models with scalable commercial pathways; however, this is examined across the 31-activity portfolio for the review's Final Synthesis Report.

Technology and Maintenance

The cases reviewed included a variety of solar-based technologies offering differing levels of service. None of them followed the same implementation model, and while all targeted rural customers, each targeted a particular customer segment. For example, MGP offered basic household electrification at a low cost, allowing it to serve those at the lower end of the income scale. HPPI's lantern rental model also targeted low-income households and even provided the flexibility to rent on a daily basis. Simpa's pay-as-you-go with purchase option for a single home-based solution targeted a slightly higher income bracket. Each technology-type was viable and well suited to the context in which the implementers were targeting. The larger conclusion is that technology choice should be context appropriate (e.g., Simpa's more expensive solution would likely not have been viable for the users of HPPI's lanterns), but as long as it meets this threshold, it is not a first-order predictor of sustainability or scale. Rather, how these technologies are maintained, and the fee structures that underpin this service are of more direct consequence.

Four of the cases (Orb not being applicable) recognized the need for maintenance and created maintenance support systems for their technology. However, the ability to maintain the systems over time varied and can reasonably be expected to vary into the future. MGP and Simpa, as commercial enterprises that own their hardware, have an incentive to maintain systems in order to continue their revenue steam. These two cases incorporated maintenance into the customer's standard fee, and they have trained personnel and a commitment to quick service. By contrast, HPPI did not appear to have the funding and processes in place to cover replacement lanterns and ensure longer-term service. To conclude, the cases that had strong customer-satisfaction incentives to maintain their products and built in fee structures to replenish resources for continued support resulted in the most widely sustained and scaled approaches.

INTRODUCTION

Portfolio Review of USAID Decentralized Energy Activities

This document presents and compares five Indian case studies that inform a wider portfolio review of USAID decentralized energy (DE) investments began between 2004 and 2012. DE in this context refers to interventions supported by USAID that generate limited wattage, serve a small number of customers per system/installation, are off-grid, and utilize clean energy technologies. USAID DE investments take the form of sectoral technical assistance, credit guarantees, enterprise support, and direct delivery modalities. Examples of the technologies supported include solar powered micro-grids, household energy systems, micro-hydro generators, and biomass installations supported by a range of business models, financing mechanisms, public policy arrangements, and capacity-building assistance for system operations and maintenance (O&M).

The range of activities representing the entire USAID DE portfolio includes 31 unique investments in 12 countries, including 2 global credit guarantee facilities. Based on criteria developed collaboratively with USAID, three countries were selected for in-depth study: India, Brazil, and Tanzania. Therefore, primary data was collected for applicable DE investments in these 3 countries, which together represent 13 case studies.[3] In a separate Synthesis Report, these case studies – the 5 India cases of which are summarized in this document – along with a literature review, summary of related performance evaluations, and descriptive statistics relating to the entire 31-activity portfolio are used to answer the review's 3 research questions:

1. To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?
2. To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?
3. What decentralized energy implementation models and processes have been most effective at achieving sustainability, scale, or replication?

USAID Decentralized Energy Investment Modalities

The USAID DE portfolio is made up of four main investment modalities. These are:

Credit Guarantees (CG): Through the Development Credit Authority (DCA), USAID uses partial credit guarantees to mobilize local financing, by covering 50 percent[4] of the principal in loans to projects that advance the Agency's development objectives. This risk-sharing mechanism encourages commercial banks and other lenders and creditors to expand credit to sectors and industries they currently do not serve, or to lend with less collateral than previously required. The expectation is that during the guarantee period, the lender will get to know the industries and associated risks so that in the future, the lender will have the confidence to issue comparable credit without enhancements.

Direct Delivery (DD): USAID activities or activity component(s) in which USAID or other donors invest the majority of the capital and other associated costs for repairing, procuring, and/or installing one

[3] Five in Brazil. Five in India. Three in Tanzania.

[4] The majority of CG activities cover 50 percent of the loan principle; however, there are exceptions. For example, a loan portfolio guarantee to a Nigerian financial institution covered up to 80 percent for loans disbursed for renewable energy promotion.

or multiple DE systems. In addition to paying for capital costs, these projects may provide training, capacity building or other technical support for the installation and/or operation of the DE system.

Enterprise Support (ES): USAID grants made directly to clean energy enterprises to support testing and/or scaling of breakthrough technologies and solutions. This may include complementary technical assistance and training to the enterprise for such purposes as business acceleration, improved management, equipment sourcing, and increased access to financing. This category includes Development Innovation Ventures (DIV) grants and grants under contracts or larger umbrella mechanisms.

Sectoral Technical Assistance (STA): USAID project or project component(s) that strengthen the enabling environment for enhancing access to clean energy services in off-grid areas. This may include, for example, developing new policies, legislation, and/or regulations, strengthening relevant Government agencies and higher education facilities, and training of financial institutions on off-grid clean energy lending.

Overview of USAID DE Portfolio in India

India Investments Included in the Review's Inventory

Within this review's full inventory of 31 activities, the India-specific portfolio was the largest, constituting 6 activities. These are:

1. Mera Gao Power (MGP),
2. Humana People to People – India (HPPI);
3. W-Power/Swayam Shikshan Prayog (SSP);
4. South Asia Regional Initiative for Energy (SARI/E) – Phase 2,
5. SARI/E – Phase 3, and
6. Orb Energy Portable Credit Guarantee.

In addition, Simpa Networks, which received a DIV grant in 2013, was included for this country report as a case study due to its comparability with other ES activities in India and among the wider global portfolio.

Five of these investments noted above are examined in-depth as case studies in this report. The Methodology section provides an overview of case selection criteria.

MGP received a USAID ES grant in 2011 as part of the Global Development Lab's Development Innovation Ventures (DIV) competition designed to support breakthrough, scalable, solutions for intractable development challenges. DIV grant funding was provided to (1) build off previous pilot-testing and test the commercial viability of MGP's solar micro-grid technology and (2) assess the development impact of these micro-grids on the lives of customers. Activities were concentrated in Uttar Pradesh. MGP reports having reached 20,000 households across 1,073 villages with its micro-grid operation. MGP's experience in scaling its model is examined as Case Study 1.

From 2009 to 2011, **HPPI** utilized a grant investment from USAID and in-kind support from the Tata Energy Research Institute (TERI) to directly provide solar lanterns to rural households in Uttar Pradesh. The activity had a women's empowerment component that supported women's self-help groups. These groups were geared towards pooled savings plans that assisted women in times of personal shocks (e.g., a family health crisis), micro-investments (e.g., to start a commercial activity), and encouraged female entrepreneurs to start up solar lantern station businesses to support the larger community's lighting access needs. HPPI's community support under this grant was largely focused in Uttar Pradesh. HPPI's activities in Uttar Pradesh relating to this USAID investment are discussed as Case Study 2.

From 2012 to 2015, **SSP** received USAID grant support for the purpose of strengthening DE distribution pathways in Maharashtra and Bihar. These funds, which reflect an STA investment approach, were provided through the Partnership on Women's Entrepreneurship in Clean Energy (W-POWER) program in India. USAID funds were used to train female entrepreneurs to sell clean energy products through associated distribution schemes. At the end of the activity, 1,010 entrepreneurs were trained, selling solar lanterns to an estimated 40,000 households. SSP's innovative distribution model is examined as Case Study 3.

Simpa Networks sells solar power through a process akin to mobile credit purchasing. In 2013 the firm obtained a USAID/DIV ES grant to test their model at scale. Specifically the grant was designed to (1) rollout Simpa's model to 12,000 households mainly in Uttar Pradesh and (2) measure the social impact and financial viability of the approach in order to attract additional private investment. Simpa's successful scaling approach is detailed as Case Study 4. Note: while the portfolio review's period of interest are investments that began between January 2004 and December 2012, Simpa's earlier sites were installed before the cutoff date, thus its inclusion in the overall portfolio.

Orb Energy is a private limited enterprise selling distributed solar PV and solar thermal water heaters. In 2012 Orb was granted access to a portable loan guarantee backed by USAID's Development Credit Authority (DCA). With the backing of this portable 50 percent CG, Orb later accessed a loan from Deutsche Bank for $1 million. The loan was used for backward integration within Orb's solar water heating business line. Orb's experience utilizing the DCA CG is detailed as Case Study 5.

FIGURE 1: MAP OF USAID-DE SITES IN INDIA

SARE/E is an energy cooperation program covering Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. The program is divided between phases, where Phase 2 (2004-2006) and Phase 3 (2007-2012) fall within the timeframe of this review. DE assistance was provided through multiple investment approaches, including the DD, ES, and STA modalities. DD assistance took the form of direct installation of solar PV, biofuel, and micro-hydro systems in rural communities across the region. A key component of Indian-specific support took the form of women's empowerment through skills training and self-help groups that linked income generation opportunities to the clean energy sector. SARI/E provided a series of small grants between Phases 2 and 3 that leveraged community engagement approaches to build local ownership of clean energy opportunities for off-grid energy generation with distinct commercial pathways. These pathways were designed to increase livelihoods opportunities while also improving energy access. The SARI/E program continues to the present, currently in Phase 4.

Figure 1 illustrates the spread of the USAID DE portfolio in India with major concentrations in the northern states of Uttar Pradesh (MGP), Bihar (Husk), and Rajasthan (Gram). Simpa is currently headquartered in Bangalore but in the process of relocating to Uttar Pradesh, where it hopes to scale-up its operations. SSP is headquartered in Pune, Maharashtra and Orb operates throughout central and southern India, but based in Bangalore. HPPI is based in Delhi and operates throughout northern India and SARI/E operations are coordinated in Delhi. While most enterprises that have received support have many dozens of installation sites, only headquarters are plotted below.

Table 1 on the following page provides additional basic characteristics of the five cases examined in-depth in following sections of this report.

TABLE 1: CASE STUDY DETAILS AND SELECTION JUSTIFICATION

Activity Implementer	USAID Investment Modality	Period	Technology	# of Beneficiaries[5]	Geographic Scope	Reason for Inclusion
Mera Gao Power (MGP)	ES	2011-2013	Low-cost solar micro-grid	Approximately 20,000 customers across 1,073 villages (as of August 2015)	Uttar Pradesh	MGP operates o/a 1,340 micro-grid installations and has successfully reached all of its required DIV grant milestones. The timeframe fits well into the review's target and allows for comparison to other implementers operating in Uttar Pradesh.
Humana People to People India	DD	2009-2011	Solar lanterns	100 solar charging stations with 60 lanterns at each station	Uttar Pradesh, HPPI has its HQ in Delhi.	HPPI's activity installed solar charging stations in four western districts of Uttar Pradesh. Lanterns were rented out using an entrepreneurship model. The timeframe fit well within this review's parameters and the location provided optimum opportunity for comparison with other activities and modalities.
W-Power; Swayam Shikshan Prayog (SSP)	STA	2012-2015	Various solar lantern models, along with a range of bundled products	Has trained 1,010 female clean energy entrepreneurs, selling lamps to 60,000 households	Maharashtra and Bihar	SSP's female empowerment and livelihoods generation model represents a key component to USAID's DE approach in India and other countries in the wider portfolio. It provides a valuable comparison with more targeted enterprise support investments granted around the same time period and in similar contexts.
Simpa Networks	ED	2013-2015	Solar home systems	14,000 customers across 1,500 villages (as of August 2015)	Uttar Pradesh and Karnataka	Provides opportunity to compare Simpa's solar home system model to the MGP's micro-grid based service and to investigate Simpa's innovative "pay-as-you-go" progressive purchasing system.
Orb Energy	CG	2012-2020	Distributed solar PV and solar thermal water heaters for residential, commercial, and industrial use	Not applicable, in the sense that funds from the DCA are meant to backwardly integrate Orb's manufacturing capacity, specifically its water heating vertical	Karnataka, Andhra Pradesh, Maharashtra, and recently established operations in Kenya.	Orb was included for in-depth study because it represents a CG, a unique investment model in comparison to the other cases reviewed in this report. Further, Orb represents one of two CG cases included as case studies (the other in Brazil), a useful point of comparison across countries and over time.

[5] The review team uses "beneficiaries" here to mean customers, clients or end-users of household targeted technologies. As USAID funding was often not associated with a specific site, the review team simply provides the total number of beneficiaries the implementer reports for their whole operation at the time of this review. Further information is provided as part of each case study later in the report.

METHODOLOGY

The overall portfolio review combines 13 in-depth case studies from 3 countries with findings from a literature review, 6 previously conducted performance evaluations of USAID activities, and descriptive statistics from the inventory of 31 activities involving DE investments that began implementation between 2004 and 2012. A full description of the study's methodology is part of the review's Synthesis Report. This section, however, provides pertinent details for the case-study work conducted in India.

As agreed in the review's research design, three frames of analysis guide the comparison of cases, both between countries and, most relevantly for this India-specific report, within countries. These comparisons are meant to provide best practices and on the ground lessons learned relating to sustained outcomes, scale, and replicability for USAID DE investments. These frames are:

1. Context factors: The policies, regulations, enabling environment and related institutional context in which DE investment are being made that can either support or hinder DE implementation.
2. Technical approach-related factors: The investment modality being used to support DE.
3. Implementation factors: The factors specific to each implementation, such as technology, maintenance systems, fee structures, etc.

Case Selection

The review team was provided a preliminary inventory of USAID DE investments by USAID and collaboratively refined the list to the final 31 investments that constitute the review's full inventory. The India-specific portfolio contains six unique investments, including SARI/E Phases 2 and 3, which are counted as separate activities. Because India was the most active country in the portfolio, the review team had the opportunity to compare multiple technical approaches and implementation factors in similar contextual environments. Noting that Uttar Pradesh represents a unique context unto itself,[6] borders the national capital (where policy officials could be interviewed), and was the setting for a large proportion of USAID DE activity in India, preference was given to activities that were active in the state. Thus Simpa, MGP, and HPPI were prioritized for in-depth study due to their focus on Uttar Pradesh. SSP, based in Maharashtra also was of keen interest because it represented a clear case of a women's empowerment and livelihoods generation scheme that is now commonly being linked to the commercial distribution of clean energy technologies. Orb was included because it was the only CG investment in the India-specific investment portfolio.

Data Collection

The team used semi-structured guides to orient procedures for in-depth interviews (IDIs) and group discussions with implementing partners, context providers, and site-specific beneficiaries. Table 2 shows the number of interviews conducted, broken down by each case study.

[6] Uttar Pradesh has among the lowest rates of household electricity access in the country. See Country Overview section for additional details.

TABLE 2: RESPONDENTS BY TYPE FOR EACH ACTIVITY

Type of Interview	MGP	HPPI	SSP	Simpa	Orb	Total
Context Provider IDIs	10 – Including MNRE, UPNEDA, KREDL, USAID, SELCO foundation, SARI/E former staff, and sectoral actors.					10
IDI (Implementer)	2	3	1	2	1	9
Beneficiary IDI	4	3	3	4	0	14
Beneficiary Group Discussions	4	3	1	4	0	12
Sites Visits	4	3	3	4	0	14

Data Analysis

The qualitative responses to the IDI and group discussions noted above were coded according to several analysis tools developed specifically for this review. These tools included:

1. Sustainability Matrices;
2. Sustainability Factors Tables; and
3. Replication and Scaling Checklists

Sustainability Matrix

The review team developed a systematic tool to assess each site visited and determine the extent to which activity outcomes were sustained. This qualitative rating tool compared activity outcomes at the end of USAID funding to outcomes at the time of field data collection for this study. The sustainability matrix includes five dimensions of sustainability:

- System production capacity;
- Current system condition;
- Maintenance capacity;
- Number of end beneficiaries; and
- Capacity to meet beneficiary needs.

The matrix uses a scale to rate the effectiveness of each dimension of sustainability:

- Total failure (0);
- Below expectations (1);
- Sustained (2); and
- Exceeded expectations (3).

The team based these rankings on a combination of data, including activity implementers' assessments of activity sustainability, triangulated with reported numbers of systems installed and information from site observations and interviews with end-user beneficiaries. The team compiled relevant data for each dimension of sustainability, then synthesized and summarized findings on each dimension of sustainability. The findings are based on the review team's observations, which may not be representative of the entire activity; instead, the matrix provides a snapshot of the sustainability of activities at visited sites. Where the review team visited more than one site per case (i.e., all but Case Study 5), the findings for each dimension of sustainability were combined into an overall sustainability ranking for the case study. Each case study write up includes this matrix as part of the report.

Sustainability Factors Table

The sustainability factors table is based on coded passages related to the contextual factors and activity-specific factors that affect sustainability, as identified in the review's literature review and confirmed in collaboration with USAID. If an activity was found to exhibit sustainability, this table is presented in the applicable case study write-up.

Replication and Scaling-Up Checklist

The review team adapted MSI's "Scaling-Up Typology" to identify factors commonly associated with replication and scaling. If a case exhibited signs of replication or scale, this checklist is provided in the applicable case study write-up.

Limitations

An ex-post review such as this poses challenges in identifying and contacting relevant key informants for IDIs. Further, case-studies were designed to collect relevant best practices and realistic implementation lessons learned for incorporation into the cross-case analysis provided in the review's final Synthesis Report. Case studies are not meant to be a formal program evaluation of that particular investment. Site visits were scheduled in consultation with the implementing partners and scheduling was reliant on their generosity of time. Sites were not randomly selected and may not be representative of the whole set of operations (e.g., MGP operates over 1,000 installations and the review team visited four). Rather, site visits were designed to provide a sense of the types of technology, beneficiaries, and common successes and challenges encountered by the partners who received USAID DE funds.

COUNTRY OVERVIEW

Indian Electric Sector

India's fast-growing energy sector currently enjoys a prominent position in the government's[7] policy agenda. The current administration has announced that it favors a more grid-integrated approach towards managing electric power distribution and has made provisions for facilitating $100 billion in investments specifically for solar generation beginning from 2014 through 2022.

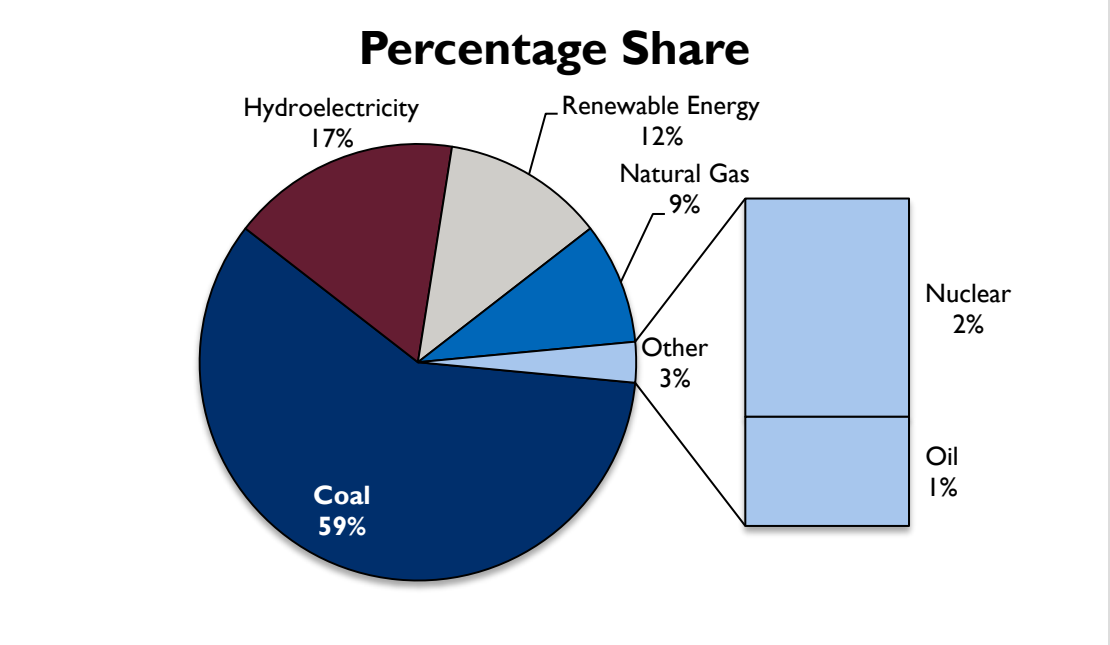
As India has set large goals towards providing affordable, uninterrupted energy access to the entire population by 2020, the challenge in completing this is made harder by the relatively low level of current access. The 2011 census showed that only 67 percent of Indian households had access to electricity (leaving roughly 400 million people without access). The vast majority of these households are in rural India (illustrated in Figures 3 through 6). A combination of great distance, less dense populations, and lower ability to pay makes electrifying all of rural India using the central grid difficult. The government has identified over 20,000 villages where grid extension is cost prohibitive; and these are earmarked for electrification using DE sources. However, the scope for application of decentralized technologies is potentially much greater than that for two reasons. First, meeting the ambitious targets for extension of the grid system within the government's proposed timeframe will be challenging, and, in the meantime, decentralized technologies may play a role in providing electricity. Second, India's grid system has both insufficient generating capacity and distribution problems (poor infrastructure leading to high losses) that

[7] The government coalition headed by the Bharatiya Janata Party was installed in May 2014.

result in regular power cuts and power quality problems. These issues are particularly acute in rural India, where grid-connected households may only receive power for a few hours per day. Decentralized technologies provide an alternative source for households in the face of an unreliable grid system.

The Indian Ministry of Power governs the overall electric generation and distribution in the country. The Ministry of New and Renewable Energy governs issues related to renewable energy. The Ministries of Coal and Petroleum are separated from the above two, but are being restructured to approach energy policy in a more integrated form. The current installed capacity in Indian utilities is 271.1 gigawatts with per capita production of 1,010 kilowatt hours (kWh) per year.[8] Figure 2depicts India's overall electrification generation landscape. India's power sector is dominated by large coal-fired power plants followed by large hydropower plants. The renewable energy sector is largely wind power as well as small hydro, biomass-based power plants, and solar. There is also a large "captive" power market (units greater than 1 megawatt serving industrial needs) and significant numbers of individually owned smaller generation units (e.g., diesel backup systems). Numbers on smaller-scale DE are difficult to obtain. However, roughly 1 million households reported having solar energy for lighting in the 2011 census, representing less than one percent of all households.

FIGURE 2: INDIA'S OVERALL ELECTRIFICATION LANDSCAPE



Household Access

As noted above, data from the 2011 census show that while 67 percent of all Indian households have electricity as their main lighting source, that figure drops to 55 percent for rural households (see Figure 3 below). The level of access to electricity varies quite widely across India; however, lighting is generally the first energy service provided when households obtain access, therefore it can act as a proxy for electricity

[8] This would be enough for supporting 8 hours of lighting, 10 hours of fan, or running small productive appliances like pump sets and refrigerators for a few hours during the day if consumed only at the household level. However, this represents an economy-wide per capita production figure (not accounting for losses). Per capita consumption at the household level is only ~100 kWh/year in rural India.

access more broadly. Figures 4 through 6 below show the main source of lighting for Karnataka (Figure 4), Maharashtra (Figure 5), and Uttar Pradesh (Figure 6) – the three states were this portfolio review conducted visits. The figures present results for households as a whole, as well as rural/urban splits. As can be seen, the second main lighting source is kerosene. Less than one percent of households report no lighting, and roughly one percent report using other sources (including solar). Kerosene use is significantly higher in rural areas across all India but varies from state to state. It accounts for approximately 45 percent of household lighting in Karnataka and Maharashtra, but 75 percent of households in Uttar Pradesh.

FIGURE 3: MAIN SOURCES OF HOUSEHOLD LIGHTING IN INDIA (%)

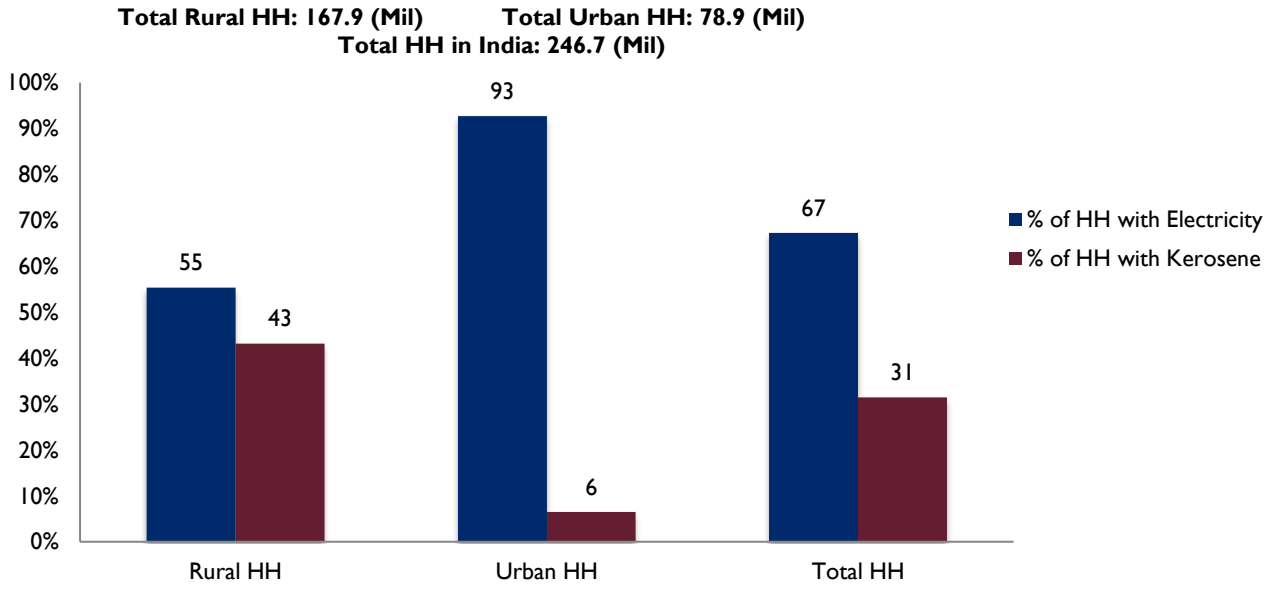


FIGURE 4: MAIN SOURCES OF LIGHTING FOR HOUSEHOLDS IN KARNATAKA (%)

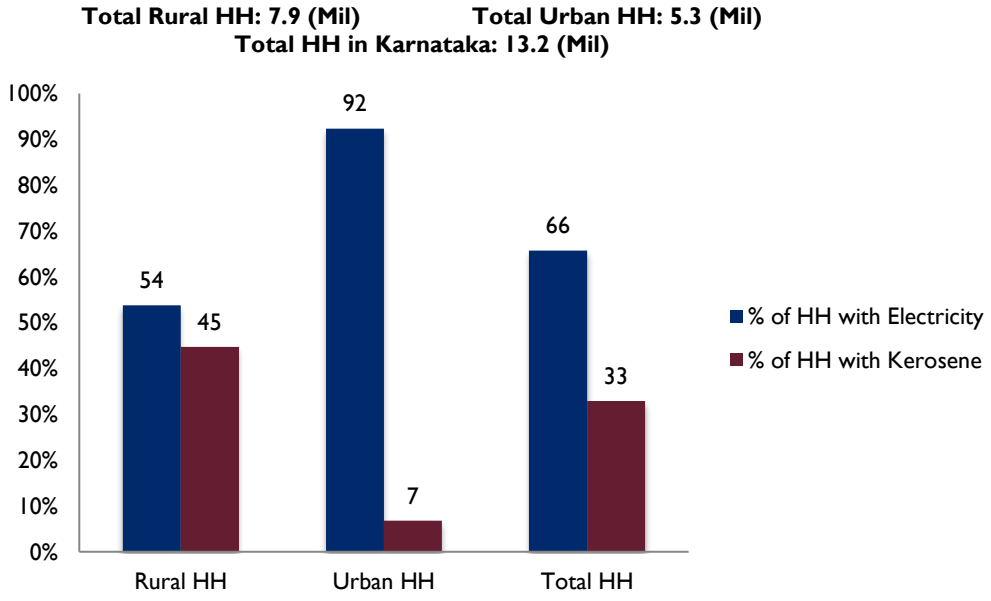


FIGURE 5: MAIN SOURCES OF LIGHTING FOR HOUSEHOLDS IN MAHARASHTRA (%)

Total Rural HH: 13.0 (Mil) **Total Urban HH: 10.8(Mil)**
Total HH in Maharashtra: 23.83 (Mil)

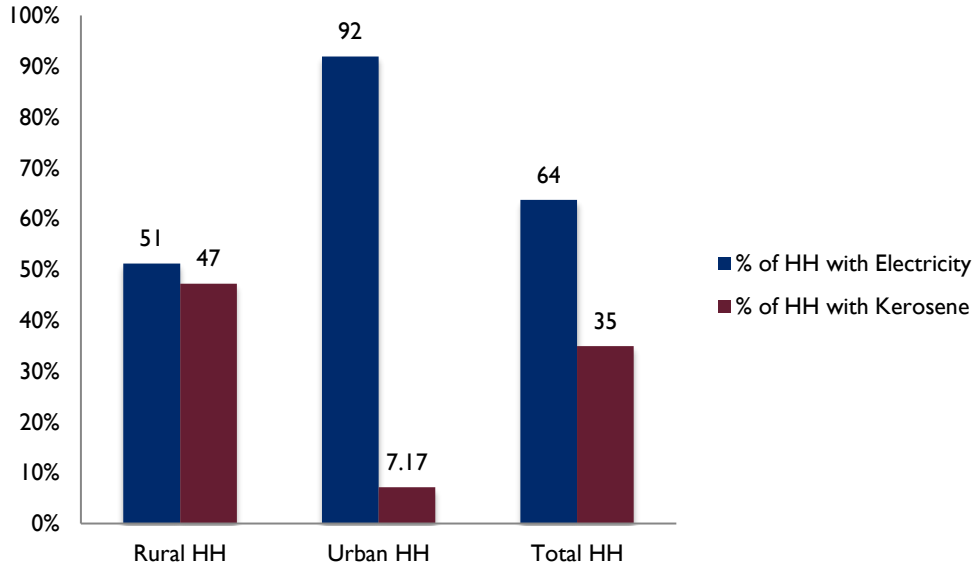
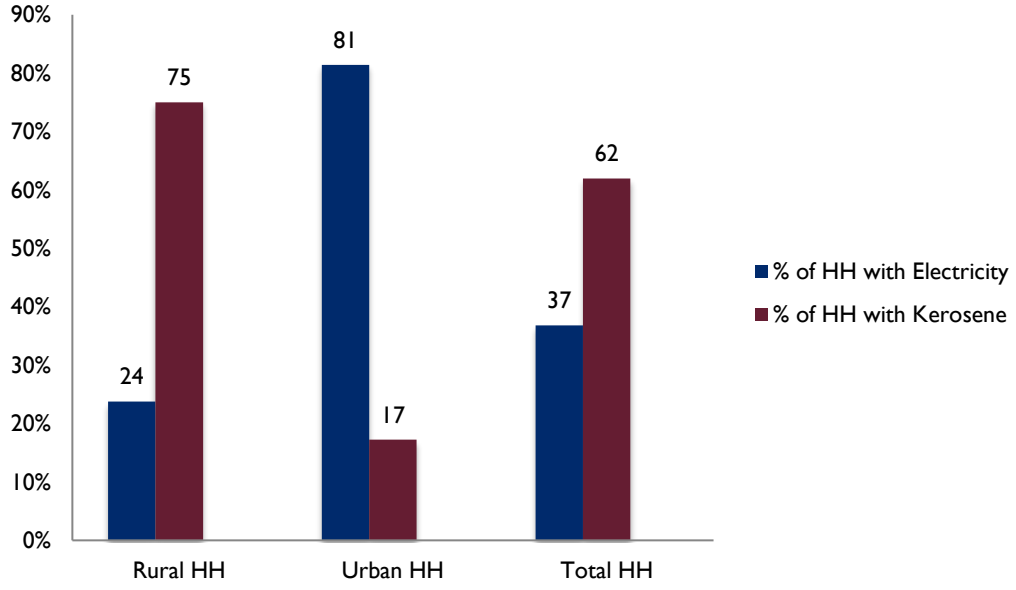


FIGURE 6: MAIN SOURCES OF LIGHTING FOR HOUSEHOLDS IN UTTAR PRADESH (%)

Total Rural HH: 25.5 (Mil) **Total Urban HH: 7.4 (Mil)**
Total HH in Uttar Pradesh: 32.9 (Mil)



DE solutions are often in competition with the presence (or possible future expansion) of the grid and with kerosene.[9] For both households and for the Indian government, DE solutions provide an attractive alternative to kerosene. For households, kerosene purchases can still represent a significant household expense that could be offset using off-grid electricity generating technologies that can also meet other energy needs (e.g., mobile phone charging) that kerosene cannot. DE also represents a non-monetary cost in terms of the health impacts of kerosene (both safety and indoor air quality). For the government, kerosene subsidies are expensive to implement and distort potential transition to safer and more effective technologies.

Policy Approaches

The Electricity Act of 2003 governs India's power sector, laying clear directives for the regulated aspects and the de-regulated aspects of the power infrastructure. This is insured by awarding distribution franchisees to interested organizations for electric metering and collection of payments and allows for foreign direct investments into the distributed energy sector. The Electricity Act of 2003, unlike its predecessors, deregulates the DE space and aims to foster innovation through private participation. There are a few schemes at the central level and separate schemes at the state level to promote DE – noteworthy schemes are the Jahawarlal Nehru National Solar Mission (JNNSM) launched in 2010 under the Ministry of New & Renewable Energy, as well as the Deen Dayal Upadhaya Gram Jyoti Yojna (DDUGJY) scheme launched in 2005 under the Ministry of Power.

JNNSM: The Jahawarlal Nehru National Solar Mission was launched in 2010 to promote rapid uptake of solar power in India. Decentralized solar power of up to 100 kilowatt peak (kWp) was supported by the Ministry of New and Renewable Energy (MNRE) under the off-grid arm of the scheme. MRNE provides financial assistance to state agencies and project developers under JNNSM. The central financial assistance of up to 30 percent is disbursed through channel partners directly to activity developers. The scheme envisages commissioning of 1000 kWp of off-grid solar by 2017. Levels as of 2014 levels are o/a 364 kWp.

DDUGJY: The DDUGJY scheme is an upgrade of the Rajeev Gandhi Grameen Vidutykaran Yojna launched by India's government in 2009. The scheme aims at providing grid-connected energy access to villages where feasible. Under the same scheme there is a provision of commissioning DE units called the Decentralized Distributed Generation (DDG) scheme. In areas where grid extension is geographically not possible or is cost prohibitive, the scheme invites projects to commission generation units using solar, micro-hydro, or biomass. The DDG scheme provides 90 percent of capital for commissioning projects and 10 percent is borne by the state government hosting the project. The Rural Electrification Corporation is responsible for financing all the projects under DDUGJY.

Apart from these national schemes, each state has their own schemes, policies, and budget allocation for subsiding renewable and distributed energy sources.

Given the relatively favorable nature of government policies, large potential market, and general global interest in providing clean, affordable, and reliable alternatives to kerosene for lighting and to provide other services, a number of private organizations have started deploying energy products, many of which involve solar-based generation or use of biomass gasifiers, sometimes coupled with smart grid technology for collection of payments. The result is a dynamic but still nascent market for DE solutions. At one end

[9] It should be noted that the other major household energy services (cooking and heating) are generally provided by either solid fuels such as woody biomass, agricultural residues and cow dung or more modern fuels such as Liquefied Petroleum Gas (LPG). There is some use of electricity for cooking purposes but it is minimal in rural areas of India due to both supply issues and cost.

of the spectrum are imported, low-cost (and sometimes low quality) solar home systems and solar lanterns sold in local shops. At the other end are new start-ups solely focused on providing energy solutions through the application of innovative technologies, business solutions, or a combination of both. However, as will be discussed further below when presenting results of the field visits, this nascent market appears to be facing some friction from three broad trends:

1. An increasing emphasis on grid extension and grid upgrading at the policy level (though with unclear prospects of success);
2. A shifting set of incentive structures (e.g., subsidies) that could either promote commercial DE solutions on the one hand or eat into their market through government provided subsidized solutions on the other; and
3. A financial sector that is not ready to support this sector as it shifts from donor support to more commercial financial transactions.

Gendered Factors Relating to DE in India

As with many countries, India has gender disparities across a range of dimensions. Males and females in India use energy differently in some important respects, and face different employment and business opportunities in the DE sector. The availability or non-availability of quick and clean energy can have significant gender differentiated impacts. Compared to other industries (e.g., apparel, entertainment, food, construction) companies operating in India's DE sector appear to pay less attention to gender differentiated energy needs and behavior when developing and marketing DE products and this may have an impact on the sustainability of DE systems.

At the household energy level, these disparities are most pronounced when it comes to cooking, heating, and accessing public areas/services after dark.[10] Many Indian households rely on solid biomass fuel burning to meet their needs, and the burdens of collecting that fuel and the health outcomes from cooking with those fuels are borne disproportionately by women. For electricity, including DE, there is great potential to improve women's lives through electrification. DE, because of its potential to extend energy access to extremely remote communities with no-grid connection, can directly impact women's livelihoods by making it possible for them to engage in small-scale productive activities, continue income generating activities after dark, mitigate the risk of leaving the home after nightfall, and reduce exposure to harmful smoke from traditional heating sources. Indirectly, the educational benefits electrification brings could mitigate gender imbalances by extending the hours in which girls and boys can study in the home.

Due to the disproportionate burden placed on women in energy poor contexts, an increasing proportion of DE interventions in India are implemented through micro-finance, community engagement, livelihoods, and workforce training approaches that target female entrepreneurs. Case Studies 2 and 3 directly examine these types of programs and a cross-case discussion on this report's findings relating to gender is provided beginning on page 59.

[10] USAID. (2015). Building a Safer World: Toolkit for Integrating GBV Prevention and Response into USAID Energy and Infrastructure Projects.

CASE STUDY SUMMARY 1: MERA GAO POWER (ES)

Activity Overview

Mera Gao Power (MGP) is a private limited company established in July 2010 with the objective of providing basic energy services (lighting and mobile charging) through a low-cost solar micro-grid to unserved/under-served rural households in Uttar Pradesh. In October 2011, MGP received a $300,000 DIV grant under the Phase 2 window. Milestones included reaching 4,480 customers across 180 villages by March 2013.

PHOTO 1: MICRO-GRID HOUSEHOLD CONNECTION POINT IN MANIHARANPURWA VILLAGE
Photo by: Narmada Purohit, MSI

MGP credits its USAID funding for helping it demonstrate the commercial viability of its business model, allowing MGP to raise further investments for scaling their operations. At the time of the review team's visit in August 2015, MGP had established 1,340 micro-grids across 1,073 villages and reached over 20,000 customers. MGP aims to reach 30,000 customers by the end of 2015.

MGP's standard micro-grid solution connects up to 30 customers within a radius of 100 meters and offers basic lighting and mobile charging for four to six hours per day. MGP owns and operates the system while customers pay a one-time connection fee and a weekly usage fee, which is minimal and comparable to existing alternatives (e.g., kerosene). MGP systems operate on a timer and do not require daily management. Periodic maintenance and fault repair of the systems are undertaken by MGP technicians. User fee collections are on a weekly basis and are modelled on microfinance operations, meaning payment is collected and managed through a self-help group.

Timeline of Operations

TABLE 3: MGP TIMELINE OF OPERATIONS

Date	Activity
2010	MGP established in Delhi, India with operations in Uttar Pradesh; Initial promoter contribution - US$30,000
2011	Grant - USAID DIV Phase 2 - US$300,000 - to demonstrate commercial viability of the business model and reach 4000 households by March 2013 (end of activity)
2013	Equity* - Insitor Impact Fund - US$500,000 to reach 11,500 households Reached 4,480 households by March 2013; 5,000 households by December 2013
2014	Award – Terra Watt Prize (National Geographic) – US$125,000 to establish 140 micro grids serving 3,500 households Grant – The Energy and Resources Institute (TERI) - US$30,000 co-financing to help reach 100 hamlets/3,000 households; Grant – TCG - US$20,000; Debt (Crowd Funding) – SunFunder - US$30,000; Debt (Crowd Funding) – Milaap – o/a US$16,500; Debt – Angel Lenders - US$100,000; Debt – Intellegrow - US$80,000; Convertible Note – Insitor Impact Fund - US$500,000 Reached 15,000 households by December 2014
2015	Debt – ICCO Investments – o/a US$500,000 up to 2020 to establish an additional 500 micro-grids/reach 10,000 households; Convertible Note – Engie (formerly GDF Suez) - US$500,000; At the time of fieldwork in August 2015, MGP had reached over 20,000 customers across 1,073 villages in rural Uttar Pradesh through 1,340 micro-grids

Purposes of USAID Funding

MGP received a $300,000 DIV grant from USAID in October 2011 in order to demonstrate the commercial viability of its business model of providing energy services through solar micro-grids in energy-poor parts of Uttar Pradesh and assess the developmental impact of these micro-grids on their beneficiaries. With the help of these funds, MGP was to establish and operate 40 village-level micro-grids serving 4,000 customers in Fatehpur and Kanpur Dehat districts in Uttar Pradesh.

Site Descriptions

The sites visited were located in Sitapur District (see below for more on change of geographic focus within Uttar Pradesh), which is predominantly rural (90 percent) and agrarian. The region is known historically for its textiles (famous for its cotton and woolen mats) and pottery. There is currently no major industrial activity, with only a few sugar, rice, and flour mills in operation. With household electrification at around 14 percent, in comparison to 38 percent at the state level, Sitapur has the second lowest electrification rate in Uttar Pradesh.

With coordination help from MGP, the review team prioritized site visits to locations that covered both early installations (supported under the DIV grant) as well as more recent MGP micro-grids. The review team also prioritized visits to locations that reflected the range of solutions offered by MGP – full systems, three-quarter systems, and half systems. The following sites, all of which were off-grid communities, were visited:

- Chikwanpurwa Village, Rampur Mathura Block, Sitapur District, Uttar Pradesh: MGP has been operating two systems in this village for a period of around 2 years – a full system catering to 22 households and a half system catering to 17 households.
- Gudyanpurwa Village, Rampur Mathura Block, Sitapur District, Uttar Pradesh: MGP has been operating a half system catering to 18 households in this village for a period of around 3 years (installed under the DIV grant).
- Maniharanpurwa Village, Rampur Mathura Block, Sitapur District, Uttar Pradesh: MGP has been operating a full system catering to 22 households in this village for a period of around 4 years (installed under the DIV grant).
- Bittapurwa Village, Rampur Mathura Block, Sitapur District, Uttar Pradesh: MGP has been operating a full system catering to 22 households in this village for a period of around 4 years (installed under the DIV grant).

Implementation Specific Factors

Technology: solar DC micro-grid system with a 240 W panel and 80 amp hours (Ah) battery; simple grid extended to households within a radius of 100 meters; timer based system with fixed hours of operation; each household gets 2 x 1.5 W LED lamps and a mobile charging point for 4 to 6 hours per day.

Target beneficiaries: poor households living in un-electrified hamlets in rural Uttar Pradesh. Full systems serve 30 customers per micro-grid. Variants of this solution include a half system (15 customers) and a three-quarters system (18 to 20 customers).

Payment methods: connection fee – Rs. 50 and weekly fee – Rs. 25. Initial collection was house-to-house by an MGP agent but that was later shifted to a group based model.

Maintenance: MGP owns the systems and is responsible for providing the trained technicians that manage the operation and maintenance of the system (including replacement of light fixtures and mobile charging cable) within the fees collected. They have a dedicated customer care number for logging and addressing complaints.

Method of planning: standardized solution/offering: baseline survey carried out to identify off-grid/underserved areas; once a village is identified as a potential site for the solution, MGP conducts a community meeting to gauge interest and ability to pay. The technical team then visits the village to assess the feasibility of installing the system in that community.

Local community involvement: community members form a group in order to accept the standardized offer with one household serving as host to the system (subject to technical constraints, e.g., concrete roof for installation of the solar panels, or central location of the household).

Other: compulsory group training provided to end users before installation of the system to prevent abuse and mishandling. Use of software systems to collect detailed data on installations and performance.

Initial challenges: challenges arise both from the external environment and from internal structures and processes. External challenges are not unique to MGP and reflect broader sectoral challenges, including political interference, threat of regulation/grid expansion, unfair competition in the market, and lack of qualified manpower in the local ecosystem. Internal challenges include manpower training and retention, adherence to processes, and monitoring of the same.

Implementation Changes Over Time

MGP has evolved to cater to changing customer needs and expectations. Major implementation changes include:

- Changes to the basic offering: while the original system was designed to cater to 100 households, this was brought down to 30, given the smaller sizes of the un-electrified communities. Further variations such as half and three-quarter systems were eventually introduced, given challenges in converting an entire community at the outset.
- Shift to Sitapur and surrounding districts rather than the originally proposed districts, Fatehpur and Kanpur.
- Shift to community engagement through MGP's own staff rather than working through an NGO.
- Payment collection was changed to a microfinance-based model, where collections by an MGP agent are at a single point in a village on a specified date and time and the entire group is responsible for full payment. MGP implementing staff report negligible default among community groups currently receiving service.
- Focused area of operations to reduce operational costs.
- Continuous in-house development on the interface electronics in order to reduce costs and increase reliability levels. Costs and reliability are improved because locally sourced manufacturing components are easier to access, and in-house technicians better understand the technology.
- Increase in connection fee (Rs. 100) and user charges (Rs. 30 per week) due to rising operational costs and standards.
- MGP is currently piloting ways of catering to additional needs for electricity (e.g., solar home systems available for purchase or rent to cater to temporary increases in electricity needs).

Status at the End of USAID Investment

When USAID investment ended in February 2013, MGP had reached 4,480 customers across approximately 180 villages, nearly meeting its milestone targets (90 percent of target). Branch offices were also established in three blocks of Sitapur district.

Key Outcomes

MGP increased access to basic electricity services (lighting and mobile charging) for o/a 22,400 individuals across 180 villages (assuming 5 people per household). For MGP, USAID funding helped the company demonstrate the viability of its business model and establish a track record that attracted additional capital from several sources, including Insitor Impact Fund,[11] ICCO, TCG, SunFunder, TERI, Nat Geo, Milaap, Intellecap, and Engie, among others.

At the time of the field visit, MGP had reached over 20,000 households serving 100,000 beneficiaries across 1,073 villages through 1,340 facilities. MGP had also expanded its geographical coverage with 19 branches across seven districts: Barabanki, Gonda, Balarampur, Bahriach, Laxminagar, and Gazipur.

Outcomes Relating to Gender

When accessing DIV grant funding, MGP stated that its initial goal was to create women's groups that would handle payment; however, early testing and "consistent advice from many organization operating

[11] Insitor Impact Fund invested US$1 million.

in Uttar Pradesh was that women's groups are very difficult to organize."[12] MGP thus organized group payments without a specific gender focus by sending a single MGP associate to a community at a specific date and time to collect the community's fees. While MGP efforts were not specifically geared towards women and lacked a direct women's empowerment agenda, milestone report documents cite the increased productivity of those with access to MGP's micro-grid system which, anecdotally, benefitted women small business efforts as well as men's.[13]

Conclusions

Question 1: To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?

Component 1a: To what extent were USAID-supported DE activity outcomes sustained after USAID assistance ended?

The systems observed at visited sites were in good condition, which was expected given that the earliest MGP installations are less than five years old. Since MGP was responsible for the operation and maintenance of the system, most customers were not fully aware of how the technical aspects of the system worked, though men appeared to be generally more knowledgeable with the technology than the women. Among both men and women, the younger community members appeared to be better informed.

The overall feedback from customer discussion groups was positive, with customers being satisfied with the service, the user charges and the response time in the event of a fault. Key benefits from the energy service highlighted by the customers were the ability to cook with greater ease, the ability for children to study under safer conditions (in comparison to kerosene lamps), added income generation due to longer hours of operation of shops/livelihood activities (only in some communities), ability to stay connected with friends and family (due to mobile charging at home), watching audiovisual content/entertainment on mobile phones, entertaining guests in the evenings, and safety from insects and snakes. However, all customers expressed a desire for additional supply to cater to their entertainment and summer cooling needs (i.e., fans).

In all the communities visited, MGP appeared to be serving no more than 50 percent of the total households in the community. One factor is the customer adoption model of MGP that is based on a self-selected group of customers being formed with one household hosting the physical system. Both group and individual customer conversations indicated that group formation was influenced by social relations within the community. Another explanation for lack of full village coverage that was offered by MGP customers was the ownership of individual Solar Home Lighting Systems by non-MGP villagers. This was partially corroborated in one village where some households had benefitted from a recently launched government scheme (Lohia Awaas Yojana). These below-poverty-line families were provided with a house and a 120 W solar home system designed to provide energy to power three lights, a fan, mobile charging and a television (a significant increase to the offering from MGP).

MGP customers appeared reluctant to speak about the systems provided under the government scheme and also felt that the MGP offering was superior. Customers further indicated that they preferred the MGP solution over privately purchased individual solar home lighting systems given that the operations and maintenance responsibility, including replacement of the LED lamps, fell to MGP. Customers also

[12] Mera Gao Power. (2013). "Development Innovation Ventures' Investment in Mera Gao Power: Final Report."
[13] Ibid.

noted the prompt and hassle-free service provided by MGP. MGP customers also indicated that they preferred the MGP solution over the grid on account of the poor reliability and service levels available from the grid as well as the perceived risk of electrocution due to the higher operating voltage of the grid.

The review team notes that the sites visited were some of MGP's earlier branches (having been established at least two years ago), where the operations were most likely to have stabilized and therefore may not be representative of the operations of all active MGP sites.

TABLE 4: SUSTAINABILITY MATRIX

Dimension of Sustainability	**Findings**	**Score** (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
System Production Capacity	Adequate for the stated service of lighting and mobile charging.	2
Current System Condition	Systems are in good condition and appear to be well maintained; no customer complaints on the hours of service.	2
Maintenance Capacity	MGP owns and operates the assets and provides prompt and hassle free service in the event of a fault; good feedback from beneficiaries.	3
Number of End Beneficiaries	4,480 at the end of USAID funding; over 20,000 currently.	2
Capacity to Meet Beneficiary Needs	While beneficiaries are satisfied, they aspire to cooling and entertainment needs which are not currently being met.	2
TOTAL		11

Component 1b: Under what conditions were USAID-supported DE activity outcomes sustained or not sustained after USAID assistance ended?

MGP operates in an environment with significant competition from several alternate solutions, such as solar home lighting solutions (market-based as well as government schemes), larger mini-grids, and the expansion of the main grid, even if the competition is often not direct.[14] MGP, as compared to other market-based solutions, has had steady growth in terms of households served. While MGP has benefited from donor funds in the past, it is not currently dependent on subsidies for its business model. Larger mini-grids, in comparison, can require significant upfront subsidies and have therefore been unable to move beyond the demonstration stage. While the expansion of the main grid was perceived to be a challenge for the survival of companies like MGP in interviews with national government officials and other sectoral key informants, officials at the state level believed such companies had a role to play in the medium-term towards addressing the energy access challenge specific to Uttar Pradesh.

Further, the grid expansion's threat to MGP's model is made smaller since MGP recovers their costs within two and a half years of operations and their assets are easily movable (can be moved as quickly as an hour). There have been several instances where the grid has already arrived but customers continue to receive service from MGP on account of the higher reliability and quality of service.

[14] Per the 2011 Census, more than 20 million residents of Uttar Pradesh live without access to electricity.

TABLE 5: SUSTAINABILITY FACTORS

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous variables		
National policies	Have had minimal impact on the ground, though it has hindered fundraising efforts, thereby limiting the pace of growth.	Lack of clarity on regulations and the potential grid extension poses a business risk in the medium term (five years and beyond).
Macroeconomic conditions	Government subsidy programs for solar home lighting systems tend to distort the market, but the target customers of MGP cannot afford the down payment under such schemes.	Government subsidy programs will continue to pose a threat.
Socioeconomic conditions	Target customers are poor rural households with low affordability levels	Customer aspirations for cooling and entertainment needs likely to increase further with increased incomes. Political risk – default due to grid expansion commitments generally made at the time of elections.
Activity-specific variables		
Community engagement	Impact so far is limited, but MGP is developing solutions to meet increased aspirations. There appear to be factions within the communities that determine inclusion in the service.	If MGP fails to develop innovative solutions to meet customer aspirations at affordable costs, political interference at the community level is likely to occur (comparison of service/tariff to other options).
Anchor institutions	n/a	n/a
Fee collection systems	Weekly collection at the community level is a plus. Weekly fees are sticky and difficult to revise unless linked to some value addition.	Working on a low cost prepaid metering solution to improve operational efficiencies.
Maintenance systems	Trained in-house staff perform installation and maintenance.	Maintenance processes are strong, but access to skilled manpower/training challenges exists.

Summary of Question 1 Conclusions

MGP has been one of the few energy service companies in rural India that operates on a non-subsidy driven business model and has witnessed rapid growth. MGP's success to date has been on account of its standardized offering that caters to the basic energy needs of their target customers at an affordable price with prompt and hassle-free service. Another critical factor that has contributed to their success has been their focused operations within a limited geography, which leads to greater efficiencies in operations. The main threat to their business is from the arrival of the main grid, but 100 percent household level connectivity and reliable energy service provision through the main grid appears unlikely in the medium term. Another factor that will determine MGP's future is their ability to develop innovative solutions to meet the increasing aspiration levels of their customers.

Question 2: To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?

Component 2a.1: Is there a secondary activity?

MGP has expanded its activities to cover neighboring districts in Uttar Pradesh, but it has not replicated the model in completely new geographies. MGP is exploring options for offering added services such as sale of mobile recharge.

Component 2a.2: How similar is the secondary activity to the original?

MGP's scale-up has been along similar lines to the original activity, with the only change being the April 2015 increase in connection fees (doubled) and weekly fees (20 percent increase).

Component 2a.3: To what extent and how was the DE activity replicated or scaled up after assistance ended?

In the two years since USAID funding ended, MGP has raised significant investments and grown rapidly to serve over 20,000 households in 1,073 villages through 1,340 systems (over 15,500 additional households since USAID funding ended). While the basic offering to the households remained the same (two lights and one mobile charging point), MGP introduced variants such as the half and three-quarters systems in order to cater to differing conditions.

Further, there are several other companies that have adopted the MGP model or a variation of the same, such as Naturetech Infra and Minda NexGen. Even a company such has Husk Power, which offered services based on larger biomass gasification-based grids, has adopted the MGP model, given the minimal demand for electricity across a majority of rural communities combined with the low willingness to pay for electricity beyond existing costs.

While the other replication efforts have not been studied in detail as a part of this review, the key difference between MGP and other companies is the level of service offered and the extent of risk transferred to the customer. MGP offers end-to-end service to the customer, thereby posing the least risk, given that it owns and operates the system, with customers paying a minimal connection fee and a weekly usage fee.

TABLE 6: REPLICATION & SCALING UP CHECKLIST

Type of scaling up	Description of observed approach(es)	Implications for sustained or continued replication
Replication	Several companies, including those operating larger mini-grids, have adopted aspects of the MGP model.	The MGP model has a role to play in the medium term, especially if the lack of clarity persists on an enabling framework for larger mini-grids and subsidies for solar home lighting systems.
Expansion	MGP has expanded to neighboring districts but it is still limited compared to the number of households without access to energy across the 72 districts in Uttar Pradesh alone.	
Collaboration	N/A	N/A

Component 2b: Conditions for Replication/Scaling up

In the absence of an enabling policy and regulatory framework for larger mini-grids, it has been difficult for companies offering such solutions to move beyond demonstration to scale up. Recent announcements from the government also suggest that the emphasis will be on grid extension rather than the promotion of isolated mini-grid solutions. Similarly, recent trends/uncertainties with respect to the subsidies for solar home lighting systems have led to reduced bank financing for such systems. In this scenario, the MGP model, based on a fee-for-service and on smaller micro-grids with lower capital investment, has a significant potential for scale up and replication in the medium term, not only in Uttar Pradesh but also other states such as Bihar, Jharkhand, Chhattisgarh, and Orissa.

Summary of Question 2 Conclusions

Given the absence of an enabling framework and an uncertain policy and regulatory environment for alternate solutions, there appears to be a significant potential for scale-up and replication of the MGP model across India in the medium term (five years). This assumes, however, that companies are able to offer innovative options to address increasing customer aspirations, a key component to further growth in the energy access industry.

CASE STUDY SUMMARY 2: HUMANA PEOPLE TO PEOPLE INDIA (DD)

PHOTO 2: HPPI SOLAR LANTERN CHARGING STATION IN ADOULI VILLAGE, UTTAR PRADESH
Photo by: Sam Hargadine, MSI

Activity Overview

Humana People to People India (HPPI) is a development organization that mainly works in five major sectors: education, environment, health, community development and livelihood and microfinance. It has reached over one million people through more than 130 development activities across 12 states in India.

In 2008, HPPI partnered with The Energy and Resource Institute (TERI) under their Light a Billion Lives (LaBL) Program for a small-scale solar charging station activity. In 2009, HPPI partnered with USAID (along with TERI as a technical partner) for an activity designed to provide solar lighting to rural households in western districts of Uttar Pradesh. Solar charging stations were installed in 100 villages in 4 western districts of Uttar Pradesh (25 villages in each district). HPPI targeted 40 off-grid villages and 60 villages with unreliable sources of power supply. Each station could charge 60 lanterns. HPPI developed an entrepreneurship model to run the solar charging stations with a "pay-as-you-go" model for daily rentals of the 60 lanterns. Besides the promotions of solar energy solutions, environmental education programs were conducted with youth and children to increase awareness on solar power. This activity also became a catalyst to create 300 women's self-help groups to improve livelihood opportunities and participate in HPPI's other activities.

The activity aimed to provide quality illumination through solar lanterns to facilitate children's education, reduce indoor smoke (by replacing kerosene), and improve livelihood opportunities. The activity also intended to promote the utilization and development of solar energy devices and services more broadly and create partnerships between government and civil society institutions that could help accelerate and expand utilization of renewable energy devices in India.

Timeline of Operations

TABLE 7: HPPI TIMELINE OF OPERATIONS

Date	Activity
1998	HPPI was founded.
2008	HPPI received the first grant from TERI under the LaBL activity to establish 18 solar charging stations in two districts in Rajasthan.
2009-2011	USAID grant for community development with solar light illumination. Milestone to be achieved was 100 solar charging stations.
2011-2012	HPPI received grant from Johnson and Johnson and installed solar charging stations and mini grids in Madhya Pradesh.
2012	HPPI received grant from MNRE under Enhanced Access to Clean Energy for installation of solar mini grids.
2014	HPPI received support to establish 400 biogas plants in Rajasthan with the support of the Ministry of Foreign Affairs of Finland to be completed in 2016.

Overview of USAID Funding

HPPI received US$450,000 under the Development Grants Program for the Community Development with Solar Illumination Project to develop a solar lantern daily rental market in 100 villages in Uttar Pradesh. The period of performance for this activity was June 2009 through May 2011. Working with its technical partner (TERI), HPPI installed the 100 solar charging stations.

Site Descriptions

The villages visited for this review were all semi-electrified.[15] All three villages were located in Badaun District in western Uttar Pradesh. Badaun district is predominantly rural (82 percent) and agrarian. Badaun is also considered one of the poorest districts in Uttar Pradesh with little industrial activity. With

[15] Initially the review team planned to visit two semi-electrified villages and two un-electrified villages; however, due to time constraints only three semi-electrified villages were visited.

household electrification at around 18 percent in comparison to 38 percent at the state level, Badaun has one of the lowest electrification rates of any district in Uttar Pradesh.

- Adhouli Village, Ujhani Block, Budaun District: The village has 500 households with a majority connected to the grid but experiencing unreliable power supply (less than 12 hours). The major occupation is farming. The solar charging station was installed in 2009.
- Narrow Village: The village consists of 150 households and the main occupation is farming, with some people migrating to cities to work as laborers. The solar charging station was installed in 2011.
- Harharpur Village, Ujhani Block, Budaun District: The solar charging station was installed in this 200 household village in 2010. The main occupation in the village is farming.

Implementation-specific Factors

Technology: Solar Charging Stations – 350 Wp (7 x 6V, 50W); 6 junction boxes with 10 charging ports each; Lantern Battery – 6V, 4.5Ah sealed maintenance free (SMF) battery; Buffer Battery – 6V 40Ah lead acid tubular plate battery for charging 10 lanterns. Lantern – lighting source of 2.5-3W and the running time is 5 to 6 hours with dimming option and mobile charging facility.

Target beneficiaries: Low- and middle-income groups in energy-poor villages in western Uttar Pradesh. Not limited to members of the self-help groups that were formed.

Payment methods: A flat Rs. 2 per day fee to rent the lantern.

Maintenance: Maintenance was to have been conducted by trained HPPI/TERI staff (see below).

Method of planning: HPPI partnered with TERI as technical partner that provided a range of technical assistance from planning to implementation of the activity, as well as to installations of the charging stations. A baseline survey was conducted to identify the target areas.

Local community involvement: HPPI engaged with the district and block development officials during the initial survey to identify potential villages for the activity. The local community also played a critical role during the implementation phase. The community leaders helped in identification of an entrepreneur and the formation of self-help groups within the community. They also participated in meetings regularly conducted by HPPI, including the initial meeting, to garner support for the activity and build trust and rapport.

Other: The USAID funding required a one-to-one match in funds. TERI provided technical support and contributed 80 percent towards the cost of 50 solar charging stations under the LaBL program, and the remaining 20 percent of matching funds came from other organizations. Additional financial support from the Gaia Movement paid for the environmental education program. The activity also collaborated with local bank managers who supported women's self-help groups and entrepreneurs that helped in development of business through microcredit.

Initial challenges: Although HPPI had a strong technical partner in TERI, there were product quality issues initially due to problems with the supplier of the first 40 solar charging stations. When this issue persisted, TERI switched suppliers after which there were no further problems with respect to quality. Since HPPI, associated entrepreneurs and technical resource people (TRP) were dependent on a single supplier, there were often challenges and delays in cases of component replacements.

Implementation Changes over Time

- Some entrepreneurs instituted an upfront Rs. 60 payment to reserve a lantern for the whole month due to increasing demand and reduced availability (reported in Adhouli village).
- Entrepreneurs were initially not provided any training on the basic operation and maintenance of the system, which led to frequent service calls. This was subsequently addressed through the introduction of a basic entrepreneur training module, with TERI support, on basic maintenance (how to clean the panel, charge the battery and lanterns, and repair the fuse).
- Six months into the activity, HPPI engaged and trained (through TERI) one TRP per 25 charging stations. HPPI/TERI also helped establish the necessary linkages between the suppliers and the technical resource person. The TRP was responsible for maintenance of the solar charging stations and was paid a fee of Rs. 200 per charging station per month by HPPI. Any component replacement costs were borne by the charging station entrepreneurs. The technical resource person also received training and refresher training during the activity period.

Status at End of USAID Investment

The activity ended in May 2011 with the installation of 100 solar charging stations with 60 lanterns at each station. Given the number of stations and lanterns and the satisfaction reported, it could be conjectured that at least 6,000 households were direct beneficiaries of improved lighting and mobile charging services, though it should be noted that the lanterns were rented on a daily basis and could be rented by different households on different days.

In addition to the direct benefits of enhanced lighting and charging services to communities, the HPPI activity also led to the formation of 300 self-help groups. Of these, 270 groups established bank accounts at local banks, and 25 groups have received a first loan from a bank. Broader environmental education programs were also conducted in schools, such as tree planting.

Status at the Time of Data Collection

Key Outcomes

The solar charging stations and lanterns functioned well initially (up to a period of two years) but started facing faults predominantly with respect to the battery. HPPI indicated that approximately 60 percent of the originally established charging stations are still operational. Further, among the sites visited by the review team, it was indicated that 50 to 60 percent of the solar lanterns were still in working order. This is not necessarily unexpected given the lifetime of the lanterns, but does indicate a lack of long-term replacement strategy to maintain service. Three of the four technical resource persons trained under the activity are still providing services to the entrepreneurs and are also expanding their business by selling solar lanterns and other devices.

The responses to these longer-term sustainability challenges varied by community. During the review team's visit to Harharpur, it was found that around 30 to 35 lanterns (50 percent) were not working. Despite these problems, there is continued demand for solar lanterns from the beneficiaries as they considered it a reliable source of electricity and flexible usage. On the other hand, in Naru, it was found

that the community interest and use of HPPI's solar lanterns had decreased due to regular faults in the solar lantern and easy availability of "Chinese torches,"[16] which are cheaper but of low quality.

The activity also created a demand for solar lanterns and even solar home lightning systems in the villages visited by the review team. For example, in Adhouli, there has been an upward trend in energy access since 2009, as referenced by the appearance of more advanced home lighting systems in some households. This was seen among families who were willing to pay a higher amount to get more facilities such as a fan or two lights. According to HPPI, it facilitated the purchase of 49 home lighting systems by customers in the overall implementation area and 200 solar lanterns at a cost of Rs. 1800. When discussing the activity with TERI, they indicated that communities gained significant benefits rising out of the HPPI activity: (1) Awareness levels on solar were higher, and (2) entrepreneur identification for its subsequent activities was easier in these districts, along with the TRPs themselves taking up the additional opportunities. HPPI also pointed to the emergence of shops that now sell solar products in the area since the activity began, which they attribute to the broader awareness and demand for solar power solutions created by their activity. The review team was able to confirm during the site visit that a number of shops were selling solar products in the area.

> "I am happy that I got a chance to make the life of people in my village better by distributing lanterns to those who need them, and it is also safe to use. By renting lanterns I have also increased our family income. I also tell people in other villages about the solar lanterns and solar power."
>
> – Entrepreneur in Adhouli Village

During discussion with beneficiaries, it was found that there is a high demand for solar lanterns as they are considered a reliable source of electricity at an affordable cost. Community members were aware of the health hazards caused due to kerosene smoke and were therefore keen to substitute kerosene lamps with solar-powered lanterns. Anecdotally, village group discussions noted that their communities are using less kerosene for their lighting needs, but this was not independently verified. According to HPPI, the average kerosene use per year per family is 60 liters. HPPI reports that over a period of time families stopped using kerosene, saving some or all of that 60 liters of kerosene by using solar lanterns.

Status of Other Stated Goals Including Gender Empowerment

Site visit respondents reported that the solar lanterns contributed to fulfilling a number of household electricity needs when grid electricity supply was absent or limited. Access to basic electricity services (lighting and mobile charging) led to direct and tangible benefits such as ease in cooking, allowing children to study at night, increases in income due to longer hours of livelihood activity, improved connectivity with friends and family, improved safety, reduced theft, being able to inspect crops at night, and feeding animals at night. Some of the intangible benefits include creating interest among children in solar energy and environmental issues, medical treatment at late hours on account of the chemist shop being open for longer hours, and the dissemination of knowledge on solar power by the representatives currently benefitting from the activity to other people in their villages and adjacent villages.

According to sectoral key informants, the outcome considered most significant pertains to the empowerment of women not only as clean energy entrepreneurs but also as agents of change towards cleaner energy options within the local community. There were also benefits from the formation of the

[16] Chinese torchlights are easily available in the market at a cost of Rs. 50 to 60 and are rechargeable. Their lifespan is two to three months.

self-help groups. Solar lantern entrepreneurs were recruited from among the women's self-help group participants, but more importantly the group served as a vehicle for HPPI to engage in other welfare-enhancing activities that are within its portfolio.

Conclusions

Question 1: To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?

Component 1a: To what extent were USAID-supported DE activity outcomes sustained after USAID assistance ended?

According to HPPI, at the time of the review, only 60 of the 100 solar charging stations were functional, and of the three villages visited by the review team, only 50 percent of lanterns associated with these functioning stations were operational. In addition, there were complaints regarding the quality and duration of light output with time, primarily on account of batteries not being replaced within the lanterns. The interviews with the entrepreneurs corroborated this fact with respect to lantern problems. Assuming the 50 percent lantern failure rate was typical of all operating solar charging stations, this represents a 70 percent drop in service post-implementation. The reasons for charging station failure are not evident since the review team did not visit any of these sites. It is possible that they faced similar problems of maintenance or might be associated with the initial poor quality charging stations procured. However, it is also possible that changes in grid electricity service also made them a second best alternative. It should be noted that the lifetimes of the lanterns are not long and so it would be expected that lanterns would start to fail during this time period. However, the funding and processes do not seem to be in place to cover replacement lanterns and ensure longer-term service.

However, several customers indicated that they would still avail themselves of the services from the charging stations provided that the lanterns were in good working order. These customers expressed satisfaction with the solar lanterns when functional, given the ease of access at an affordable cost without being responsible for maintenance. This suggests that the activity probably did not adequately factor in the costs towards system maintenance and replacements, although the entrepreneur displayed a clear understanding of operating and maintaining the charging stations as well as the limitations of systems. There were a few other customers, however, who aspired for more energy to cater to the lighting requirements in different area within their house, cooling needs and entertainment (television).

However, given that the activity was implemented at a time when solar energy was not as prevalent, it appears to have generated significant awareness and demand for solar lighting solutions, which came across during the group discussions with the community members.

It was also found that the technical resource persons in at least three districts continue to provide service even after the activity ended and have independently scaled up their engagement in solar energy. This was corroborated by TERI, who indicated that the TRPs remained involved in subsequent efforts of TERI under a different program.

TABLE 8: SUSTAINABILITY MATRIX

Dimension of Sustainability	Findings	**Score** (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
System Production Capacity	Only 60 percent of charging stations of the original 100 are providing any service. Between 50 to 60 percent of the lanterns	1

Dimension of Sustainability	Findings	Score (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
	in each solar charging station that was visited and is functioning are still providing lighting at the same capacity.	
Current System Condition	Same as above.	1
Maintenance Capacity	The trained TRPs were effective in maintaining systems, and some still provide service, but no one has replaced or repaired failing technology.	1
Number of End Beneficiaries	HPPI reported 6000 lanterns and 39,000 beneficiaries at the end of the activity period. Extrapolating from fieldwork, approximately 2,000 lanterns might be still working and charged from the stations.	1
Capacity to Meet Beneficiary Needs	Beneficiaries able to obtain lanterns are satisfied due to good capacity of lightning, reliability, and flexibility in usage, but they aspire to higher systems.	2
TOTAL		6

Component 1b: Under what conditions were USAID-supported DE activity outcomes sustained or not sustained after USAID assistance ended?

The outcomes of the activity were not sustained to the extent expected, primarily due to technology failures over time as discussed above. However, evolving market dynamics over time with more options for solar lanterns and solar home lighting systems, which catered to the aspirational energy needs of the customers, did result in some of the customers' switching from the service available from the charging station entrepreneur. Further, better availability of supply on the main grid may have also led to some of the charging stations' not being operational, though this has not been verified.

However, it was reported that the activity led to greater awareness on solar energy, which may have made it easier for later entrants in the market.

The factors that affect sustainability are summarized in Table 9.

TABLE 9: SUSTAINABILITY FACTORS

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous variables		
National policies	Government has implemented Ram Manohar Lohia Scheme and provides home lightning systems. Grid extension is occurring and proposed to be expanded.	This scheme could potentially result in the closing down of the partially functioning charging stations. Extension of the grid (particularly accompanied by improvements in reliability) could obviate the need for solar lanterns.
Macroeconomic conditions	No specific macroeconomic factors played a role in sustainability.	

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous variables		
Socioeconomic conditions	Reduction of household expenditure on energy.	HPPI long-term sustainability may not be affected by socioeconomic conditions as much as by competition by other sources that can provide more service and by their declining reliability.
Activity-specific variables		
Community engagement	High community involvement.	Despite the high degree of community engagement, the activity could not be sustained since the business case was not established. However, the activity led to significant steps with respect to women's empowerment, which may be sustained.
Anchor institutions	N/A	N/A
Fee collection systems	Pay as you go system is an advantage for the customer.	While the rental/pay as you go model is an advantage to the customer, it poses a risk for the entrepreneur, with customers opting out of the service at the slightest problem, as is witnessed in this activity.
Maintenance systems	Installation and maintenance is done by trained TRP but insufficiently funded and implemented.	Lack of viable model to replace lanterns and make repairs outweighs continued presence of trained maintenance personnel.
Other: Competition	There is an increased demand for solar power and more advanced technology with greater capacity. Other service providers are selling similar products.	With a more advanced appetite for energy products, this technology is unlikely to continue to meet community demands.
Other: Supporting Institutions	TERI still providing technical support to trained technicians.	Without continuous technical and financial support to TRPs, it would not be sustainable.

Summary of Question 1 Conclusions

While the charging stations established under this activity are not sustainable since the maintenance and replacement costs have not been adequately factored in, the activity itself has generated significant awareness for solar power solutions in the villages. Further, the TRPs established under this activity have been incorporated into subsequent activities of TERI and have scaled up their engagement in solar energy. The market for solar energy has grown significantly since then as witnessed at the block level markets where new "Saur Urja shops" are displaying a number of solar products.

Question 2: To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?

Component 2a.1: Is there a secondary activity?

HPPI**,** with the support of Johnson and Johnson**,** commissioned 10 solar charging stations in partnership with TERI in Shoepur District, Madhya Pradesh, from 2011 to 2012 (after USAID assistance ended on the original activity). In line with market trends, HPPI also switched from charging stations to mini-grids, given the maintenance issues associated with lanterns. They deployed 20 mini-grids in the same district (also

with TERI). HPPI has also partnered with Minda for establishing mini-grids in Hardoi and Unnao districts of Uttar Pradesh.

Component 2a.2: How similar is the secondary activity to the original?

The main secondary activity is very similar (solar charging stations with lanterns), with small differences on two aspects: maintenance approach and a deposit paid by the entrepreneur. Given the market trend towards entrepreneur-centric models, HPPI partners expected greater investments by the entrepreneurs towards the capital cost of the system (though this was not easy for HPPI in the case of the local/women entrepreneurs). Further, HPPI opted to not engage a technical resource person since maintenance services were offered by the supplier itself. However, this may lead to problems in the future, given the reported high transaction costs of maintenance services from the supplier.

TABLE 10: ORIGINAL AND SECONDARY ACTIVITY COMPARISON

Component	Comparison	
	Original Activity	**Secondary Activity**
Technology	Solar charging stations with lanterns.	Solar charging stations with lanterns.
Fee structure/payment method	A fee of Rs. 2 per day by cash.	A fee of Rs. 2 per day by cash.
Maintenance plan	Technical resource person received training and tool kit.	Due to limited solar charging stations (10) so no TRP, and the supplier was responsible for maintenance.
Intended use	Lighting and mobile charging.	Lighting and mobile charging.
Community engagement strategy	Limited engagement.	Limited engagement.
Use of an anchor institution (or not)	TERI provided technical and financial support and provided training to entrepreneur, technicians and identification of suppliers.	TERI provided support in identification of suppliers.

Component 2a.3: To what extent and how was the DE activity replicated or scaled up after assistance ended?

There was a limited attempt to replicate the model in another district but with only 10 percent of the deployment of the original USAID activity (10 solar charging stations rather than 100). This was through donor funds from a foundation rather than an entrepreneur or market-based approach. The more limited funding led to lower implementation. Similarly, the move towards micro-grids (which can be seen as a shift in the approach rather than replication or scaling) was limited. However, the increased awareness levels on solar energy have arguably led to increased adoption from other providers, as witnessed in the responses from customers.

Component 2b: Conditions for replication/scaling up

While some beneficiaries expressed satisfaction with the energy services they received through the lantern rental system, the activity was hampered by the lack of a viable business model that accounted for ongoing replacement and maintenance costs and by increasing aspirations of its customer base. Replication or scaling up would effectively mean both a more entrepreneur-centric approach that was less reliant on donor funds and a customer base that was well matched to the limited service lanterns could provide. HPPI as an organization focuses on integrated community development and implements needs-based activities and is not necessarily focused on creating new business enterprises. However, Shoepur district in Madhya Pradesh, where HPPI was trying to replicate its model, could be a good candidate site. It is a tribal region and the end users are particularly poor with farming as their main occupation. They have few resources and services (e.g., health, education, and electricity) or alternative livelihood opportunities.

Beneficiaries could get access to household lighting, and the flexibility provided with lanterns can be used for pest inspection, for example, as long as systems are in place to ensure long-term operations.

Summary of Question 2 Conclusions

HPPI is active in a number of Indian states, working mostly on small-scale community development activities. As reported from HPPI's activity implementers, replication of the USAID supported work would be possible in the other energy-poor and semi-electrified areas in which they work, especially those targeting low-income rural groups who cannot afford home lightning systems and have no other sources of lighting available. HPPI's streamlined approach to payment and maintenance would likely support replication and scale-up of this type of activity, if it received continuous funding. However, without a change in the grant-based model, replication will likely lead to similar outcomes as in Uttar Pradesh over time. That is to say that to scale this type of model, the constraint of financial self-sufficiency will likely need to be addressed.

CASE STUDY SUMMARY 3: W-POWER, SWAYAM SHIKSHAN PRAYOG (STA)

Activity Overview

PHOTO 3: ENTREPRENEURS DISCUSS SERVICES PROVIDED AT THE W-POWER HUB IN LATUR DISTRICT, MAHARASHTRA

Photo by: Narmada Purohit, MSI

Swayam Shikshan Prayog (SSP) is a development organization established in 1990 with roots in the reconstruction and rehabilitation efforts in disaster prone areas of Maharashtra. It aims to empower rural women as entrepreneurs and leaders through self-help groups, social enterprises and community-led initiatives. SSP operates in 13 of the most disaster-prone districts of Maharashtra, Gujarat, Tamil Nadu, and Bihar. It offers a large range of services through its social enterprise ecosystem, made up of the following: (1) Sakhi Social Enterprise System (SSEN) in skills and entrepreneurship; (2) Sakhi Unique Rural Enterprise (SURE) in rural marketing and distribution; (3) Sakhi Arogya Samudaya Trust (SAST) in preventive health enterprises; and (4) Sakhi Samuday Khosh (SSK) in innovative finance.

SSP, with the support of USAID, implemented the Women Entrepreneurship in Clean Energy (W-Power) activity during the period 2012 through 2015 across six underserved districts of Maharashtra and two districts in Bihar. The program aimed to increase awareness of clean energy solutions, primarily solar lanterns and improved cook stoves, and develop a distribution network of 1,000 Sakhis/rural women entrepreneurs for effective delivery of these solutions.

Also as part of the activity, W-Power launched a clean energy hub in Latur District of Maharashtra that connects Sakhis and consumers with diverse partners such as private technology firms, banks, and public energy agencies. The hub facilitates access to products, technology and finance for Sakhis, while consumers and partners can receive a demonstration of the product in order to experience it firsthand.

Timeline of Operations

TABLE 11: SSP TIMELINE OF OPERATIONS

Date	Activity
1989	SSP was established in Mumbai as a development organization focused on women training & empowerment.
1998	SSP received recognition as "Community Participation Consultant" by Government of Maharashtra under the Earthquake Disaster Project in Maharashtra (post the 1993 earthquake)
2006	First foray into energy when SSP was selected by C.K. Prahalad's team (Harvard University) as a co-creation partner with BP Energy to address the cooking energy challenge for the "bottom of the pyramid" (BoP) market
2007	As a result of the BoP partnership, SSP developed a biofuel stove. An independent company, Adharam Energy Private, Limited, was then formed for stocking and distributing the biofuel & stoves in SSP areas. Access Distribution for door-to-door sales of locally produced grocery items.
2009	SURE was established through the consolidation of Adharam Energy Private Limited and Access Distribution. SSEN was established to manage two major programs focused on vocational skills and placements, as well as rural entrepreneurship.
2012	USAID $1 million grant support towards W-Power.
2013	Received US$15,000 as an award from Sankalp Global Cookstove Alliance Award for innovation in clean cooking solutions.
2014	Recipient of the Best Innovation Award at the Maharashtra Rural Livelihoods Innovation Forum for its work on Social Entrepreneurship and Inclusive Business Models. Recipient of the Best Innovation Award at the Bihar Innovation Forum for its work on rural energy services.
2015	SSP held the W-Power Global Partnership Forum to facilitate exchange between similar initiatives in India and Africa.

Overview of USAID Funding

SSP received a US$1million grant from USAID to empower rural women as clean energy entrepreneurs in energy poor districts of Maharashtra and Bihar. The period of performance for this activity was from October 2012 to September 2015 with a target of training 1,000 entrepreneurs. With the help of these funds, SSP has created an entrepreneurship network of over 1,000 rural women through a comprehensive training module on clean energy technology, products, business and entrepreneurial skills, and setting up a business initiation event aimed to establish entrepreneurs as clean energy shopkeepers.

Site Descriptions

The review team visited sites in two districts of Maharashtra: Latur and Osmanabad. Latur and Osmanabad are among the lesser urbanized districts of Maharashtra with 25.5 and 17 percent urban populations respectively, as compared to the state level urbanization of 45.2 percent. Both districts are predominantly agrarian with 71.5 percent of the population in Latur and 77.1 percent of the population in Osmanabad engaged in agricultural and related activities (including some industrial scale sugarcane production). Household electrification is reasonably high in both districts, with approximately 80 percent of the households in Latur and 70 percent of the households in Osmanabad having access to electricity. However, availability and reliability of supply is considered to be poor (as per feedback from entrepreneurs and beneficiaries to the review team), with o/a 8 to 10 hours of supply per day. There is some penetration of

solar energy solutions in these districts as well at around 0.1 percent of households according to the 2011 census.

Latur and Osmanbad were also selected for site visits due to the large numbers of entrepreneurs under the W-Power program in these districts (Latur: 190; Osmanabad: 189). This is because SSP initiated its operations in these districts and has been active for over 20 years. Further, the pilot Energy Hub Center, which was an innovative concept established under the W-Power activity and deemed of interest to the review, is located in the Latur district. With the help of SPP, the review team visited locations to meet with both new entrepreneurs/Sakhis and experienced ones, all of whom received training as part of the activity.

During visits to Kotla, Naigaon, and Ekurga villages, the review team met with new entrepreneurs identified. Details of the villages visited are below:

- Kothala Village, Kalamb Block Osmanabad District, Maharashtra: the village consists of 350 to 400 households with farming as the main occupation. The majority are connected to grid supply, but they are experiencing unreliable power. The entrepreneur who lives here received training in 2013.
- Naigaon village, Kalamb Block, Osmanabad District, Maharashtra: the village has 300 to 400 households and the main occupation is farming. The entrepreneur here has a tailoring business, and she received entrepreneurship training in 2013.
- Ekurga Village, Latur Block, Latur district, Maharashtra: the village has 450 to 500 households with a majority connected to grid supply but experience unreliable power. The villagers work as laborers for agriculture and also in a sugarcane factory. The entrepreneur here has a tailoring business and she received entrepreneurship training in 2012.

The review team also met with several experienced entrepreneurs/Sakhis, from different districts who were participating in a training program at the energy hub in Latur.

Implementation-Specific Factors

Technology: while SSP has experimented with several lighting and cooking products, they primarily distributed solar lamps from D-Light and forced draft cook stoves from First Energy. There are three variants of solar lights:

1. S2 (Learning Light);
2. S20 (Family Lantern); and
3. S300 (multi-function versatile light with mobile charging).

The S2 is an adjustable solar reading lamp, which is three times brighter than kerosene, with an integrated solar panel that offers over four hours of lighting when fully charged. The S20 is similar to the S2 with the added feature of a dual lighting setting, with eight hours of operation on the lower setting. The S300 is a larger lamp with mobile charging, which is 10 times brighter than a kerosene lamp, with a separate solar panel that offers 4 to 16 hours of lighting. The most popular light in SSP's area of operation is the S20. The Oorja K3 DLX home use stove from First Energy is a forced draft pellet-based gasification stove that is intended to offer liquefied petroleum gas (LPG) like performance. Pellets are made from agricultural residue, and SSP also established women entrepreneur based decentralized pellet manufacturing units to control the cost of pellets. While SSP's foray into energy was through improved cook stoves, the market for household cook stoves has suffered due to issues in supplying the processed pellets needed for the particular cook stove model being sold.

Target beneficiaries: low and middle income group in energy poor villages in Maharashtra.

Payment methods: The solar lanterns cost between Rs. 450 to 2000, and the improved cook stove costs approximately Rs. 1,500. Sakhis sell the products independently and are responsible for collection of cash payment. Sakhis offer limited credit to customers on an ad-hoc basis. There have been efforts under a recent pilot to provide formal end-user financing through SSK for a bundle of products comprising a lantern, cook stove, water purifier, and pre-fab toilet, although the financing is predominantly for the toilet, which is significantly more expensive compared to the lantern and the cook stove.

Maintenance: one trained technician per district, who was an employee of SURE and was trained by the different product suppliers, was responsible for maintenance services. Funds to pay for the technician came from the margins on the products sold.

Method of planning: SSP targeted large rural communities that not only have a need for energy back-up due to inadequate supply from the grid but also offered a significant market for potential clean energy entrepreneurs. Towards this, a rapid baseline assessment was conducted across villages in the target districts to understand the potential for clean energy solutions as well as availability of potential women entrepreneurs/Sakhis, with existing businesses. Sakhis identified were then provided with basic training before being integrated into the clean energy supply chain, which provided them with access to technology, finance and other support services.

Local community involvement: local community leaders, (e.g., the village leader) were involved in the planning process. The village head suggested the names of potential candidates who would likely be well suited to become Sakhis. They also participated in the business initiation event so as to give visibility to entrepreneurs/Sakhis in the village and at the block level.

Other: The technicians received training for maintenance by the product suppliers. The entrepreneurs gave the beneficiaries some basic training on usage of solar lamps and simple maintenance. Demonstrations of solar lamps were also done in the weekly market to make them aware of the convenience and ease of maintenance. This is a semi-commercial model in that the profits from lantern sales are sufficient to cover the Sakhis' costs but do not include programmatic support costs (such as training) and some of the maintenance costs that are covered directly by SSP/SURE.

Initial challenges: According to SSP, ensuring that Sakhis remained available through the entire duration of trainings, especially during festivals was a key challenge.

Implementation Changes over Time

While Sakhis identified in earlier activities were women who were active in their local community, the focus in the current initiative was specifically on women with existing businesses, who had a greater chance of success.

In a pilot activity implemented with PATH during this period, SSP introduced a bundle of products comprising a solar lamp, improved cook stove, water purifier and toilet with financing options (particularly necessary given the Rs13,000 cost of the toilet). This brought together prior experience in promoting some of these technologies (even before USAID funding) and the entrepreneurship training under the USAID activity.

During the implementation, there was a perceived need for a hub, which would provide a platform for effective engagement between the various stakeholders (SSP, Sakhis, consumers, product suppliers, and financiers). Accordingly, a Clean Energy Hub was established at Latur on a pilot basis, where all the products within the SSP portfolio are displayed and Sakhi trainings and product testing and marketing sessions are conducted.

Status at End of USAID Investment[17]

During the course of the USAID funding, SSP trained 1,010 female clean energy entrepreneurs, out of which 835 entrepreneurs are based in Maharashtra and the other 175 in Bihar.

Key Outcomes

By 2015, the entrepreneurs sold solar lamps to 40,000 households across six districts of Maharashtra. SSP and the entrepreneurs conducted awareness-raising activities on the usage and benefits of clean energy products through market stalls, community group meetings, and wall paintings, and have reached out to 1,010,000 people in Maharashtra, according to SSP.

During data collection it was found that the activity has led to an increase in knowledge on clean energy products, as well as business and entrepreneur skills of the Sakhis. Out of the three types of solar lamps, S20 (family lanterns) was the biggest seller as it is convenient and flexible to use and easy to carry.

The review team met both new and experienced entrepreneurs, and most of the Sakhis reported a rise in their level of confidence since they feel that they have become more informed and can communicate the information about the product features and benefits to the consumers. There is an increase in mobility, and they are marketing the clean energy products not only in their villages but also in nearby communities.

Most of the entrepreneurs stated that their decision-making capacity has increased after the capacity-building workshop. The new entrepreneurs in Osmanabad stated that now they play a role in the decision-making process in their households as well as at the community level. Family members consult them to arrive at family decisions. They also attend village meetings and give their views in the meetings. While there is likely selection bias in terms of respondents as the review team was speaking towards more active Sakhis in the network, the fact that they had experienced a "before-after" change in their perception of their empowerment was notable for the review.

> "My hesitation to speak up has gone now. I can speak in front of villagers in the panchayat meetings."
>
> - Sakhi in Kotla Village, Osmanabad District

The Sakhis expressed that they felt satisfied being clean energy entrepreneurs as they are working for a social cause and are selling clean energy products, which are safe for their communities. It also has enhanced their social status and recognition within their villages. The activity has enabled the entrepreneurs to contribute to household income. The beneficiaries also showed a level of satisfaction with the solar lamps, as it is a reliable source of lighting at an affordable cost.

Status of Other Stated Goals Including Gender Outcomes

Creating a vehicle for the development of women entrepreneurs was arguably just as important a goal for SSP as the specific implementation of solar energy systems. The SSP activity has empowered entrepreneurs at an economic and social level benefitting not only participating rural women entrepreneurs, but also expanding community access to clean energy. According to interviews at the Latur Energy Hub, benefits to the Sakhis include social prestige as well as an increase in monthly income. In 2014, SSP introduced the

[17] Unlike other activities visited, data collection occurred roughly contemporaneously with the end of USAID funding.

bundling of products to enhance the business opportunities of entrepreneurs and increase usage of clean energy products, which is slowly gaining momentum.

> "I stood in the last election and now I am a member of the Gram Panchayat."
>
> - Entrepreneur, Latur District

SSP's contribution to women's empowerment was evident from interviews with the experienced Sakhis at the Clean Energy Hub. According to SSP, and entrepreneurs the review team interviewed, there was an increase in adoption to solar lamps in place of kerosene due to the greater degree of convenience and health benefits from not inhaling harmful fumes. The entrepreneurs have become more independent and feel empowered due to additional income. The Sakhis interviewed indicated that they spent some of these funds on their children's higher education, as well as investing in new clean energy products or new business opportunities.

Conclusions

Question 1: To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?

Component 1a: Sustainability

The activity of SSP ended in September 2015, therefore the review team cannot fully examine the sustainability of this activity. However, according to SSP, and as verified by the customers interviewed, the solar lamps sold by the entrepreneurs are functioning well thus far. The life span of the solar lamps is two years, and during the site visits it was found that the solar lamps were performing as per specifications. Where product failure was witnessed, the products were serviced or replaced within the stipulated time period of one week. While the entrepreneurs were satisfied with the service provided by the trained technicians, there were some issues with respect to the time taken for such service, since the product had to be shipped back to the district headquarters for servicing. In order to address this, SSP was therefore experimenting with the concept of training Sakhis to take care of the basic servicing needs of the products. The review team interviewed Sakhis participating in such a training and found the Sakhis to be reasonably enthusiastic to learn the technical aspects of the products.

While SSP/SURE have been looking to expand their product portfolio to generate more business for the Sakhis, the biggest seller in the last three years is the S20 model, which offers a low margin profit. While this margin is sufficient at the Sakhi level, it is not sufficient to cover the costs of the distribution and support infrastructure established by SSP/SURE. While SSP has been encouraging product suppliers to make long-term investments into the creation of such distribution infrastructure, they have been unsuccessful thus far in this regard.

TABLE 12: SSP SUSTAINABILITY MATRIX

Dimension of Sustainability	**Findings**	**Score** (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
System Production Capacity	Adequate	2
Current System Condition	The lamps were in good condition and there were no specific complaints given to the review team.	2

Dimension of Sustainability	Findings	Score (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
Maintenance Capacity	The trained technician provides maintenance and beneficiaries reported satisfaction.	2
Number of End Beneficiaries	60,000 household end-user beneficiaries with 1,010 entrepreneurs.	2
Capacity to Meet Beneficiary Needs	Flexibility to use and provides quality lighting. Beneficiaries seemed to be satisfied, especially as a backup to the grid.	2
TOTAL		10

Component 1b: Conditions for sustainability

While it is difficult to comment on this since the activity was just ending at the time of the review team's visit, SSP did indicate that they were in advanced discussions with several donors and government agencies who were interested in supporting SSP's activities as a follow-up to W-Power. However, to the extent that the activities undertaken within the W-Power program towards capacity building of entrepreneurs and awareness creation within the target market have not been absorbed fully within SURE or its partner companies supplying products, such activities will continue to require soft support in order to be sustained.

SSP has also been introducing new business opportunities for entrepreneurs that are not limited to solar lamps, stoves or toilets in order to encourage the entrepreneurs to diversify their business. For example, with SSP support, one of the entrepreneurs in Ekurga village (Latur) has started selling women's jewelry. SSP is also conducting refresher training courses with the entrepreneurs to enhance their business skills, improve their communication skills and facilitate regular discussions with experienced entrepreneurs who can share their experiences and discuss successful strategies for reaching out to a large number of customers.

TABLE 13: SSP SUSTAINABILITY FACTORS TABLE

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous Variables		
National policies	State Rural Livelihood Projects, which are promoting clean energy enterprises. There are plans for the government to launch a Start-up Village Entrepreneurship Program (SVEP) with SSP.	Government initiatives may help the SSP entrepreneur model indirectly.
Macroeconomic conditions	No macroeconomic factors have been identified that played a role in sustainability	Not Applicable
Socioeconomic conditions	Entrepreneurs have developed skills to professionalize their business. The low margin makes it harder to generate a sufficient income with only clean energy products. The use of the solar lamps has an impact on small businesses that can now run their business for longer duration, which can add to household income.	SSP continued service and timely maintenance to the beneficiaries would lead to sustainability in future.
Activity-specific variables		

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous Variables		
Community engagement	SSP sought active participation of community members in the planning process that lead to better trust and acceptance.	Involvement of community leaders may ensure increase in access to clean energy products and would have an impact on future sustainability. Pro-active role by SSP in introducing and promoting new products for entrepreneurs may have an impact on sustainability.
Anchor institutions	N/A	N/A
Fee collection systems	Payment in installment by cash is convenient and makes the system affordable for end-users. Revenues are only sufficient to cover direct purchasing costs and not programmatic and maintenance costs.	Continued reliance on donor funds, in particular for maintenance, may limit continued sustainability. Lack of access to consumer financing limits market.
Maintenance systems	Low maintenance requirements for the solar lamps.	Regular maintenance by the service technician likely would maintain the sustainability of the equipment for longer.
Other: Ongoing Training	Refresher course trainings are provided to Sakhis at regular intervals to enhance their entrepreneur skills.	Continuous mentoring of Sakhi by SSP officials would ensure growth.

Summary of Question 1 Conclusions

Based the interviews conducted with the available experienced Sakhis at the Latur center, SSP has strengthened the network of entrepreneurs through capacity-building workshops. They have equipped the entrepreneurs with knowledge regarding the specific clean energy products on offer. Hence the entrepreneurs are able to communicate information about product features and benefits to customers and generate awareness on clean energy and selling clean energy products.

The entrepreneurs also reported experiencing a holistic transformation in their lives. They perceive an increase in economic growth opportunities that allows them to contribute to household income and play a role in decision-making processes at the household level. The additional income generated helps in providing a better education to their children and an improved quality of life.

The beneficiaries are also satisfied with the solar lamps sold by the entrepreneur as it is convenient and flexible to use (e.g., they can carry the lamp to the field at night). One interviewee stated that they used less grid power due to the existing investment in the solar lamp and the unreliability of the grid supply.

SSP also introducing new concepts and products to enhance the business opportunities and keep motivating the entrepreneurs so as to reach out to a large population.

Question 2: To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?

Component 2a.1: Is there a secondary activity?

To date there has not been a secondary activity as the primary activity has just ended**.** According to SSP there is an interest shown for replication of the model from development organizations in Assam, Odisha, Tamil Nadu, and Rajasthan.

Component 2a.2: How similar is the secondary activity to the original?

Not applicable

Component 2a.3: To what extent and how was the DE activity replicated or scaled up after assistance ended?

Not applicable

Component 2b: Conditions for replication/scaling up

Not applicable

CASE STUDY SUMMARY 4: SIMPA NETWORKS (ES)

Activity Overview

Simpa Networks is a private limited company established in 2010 with the objective of providing energy services through distributed solar solutions on a pay-as-you-go (PAYG) basis to under-served rural households in India. Simpa began operations in India in 2011, when it implemented its initial pilots of the PAYG unit in Southern India in partnership with SELCO. In 2013, it altered its business model to provide end-to-end distributed solar solutions on a PAYG basis to its consumers and shifted its geographic focus to Uttar Pradesh. In May 2013, Simpa received a US$968,000 DIV grant under the Phase 2 window. Milestones included reaching 12,000 customers.

Simpa credits its USAID funding for helping it demonstrate the commercial viability of its business model, allowing Simpa to raise further investments for scaling its operations. At the time of the review team's visit in August 2015, Simpa had reached 14,065 customers, of which 500 were in Karanataka and the rest in 1,500 villages across eight districts in Uttar Pradesh. Simpa aims to reach a million customers across 168 branches by 2019.

Simpa offers energy services through standardized solar home lighting systems that provide lighting, cooling, and mobile charging for 5 to 15 hours per day. Simpa owns the system and provides the customers with a right to use it against a down payment and a daily usage fee. Customers have the flexibility to recharge the system according to their needs and affordability through payment points that are located within a distance of 7 to 10 km. Customers also have the option to either return the system or purchase it at the end of 6, 12, 18, or 24 months at prices that are stipulated upfront. System service and maintenance services are provided by technicians who are either Simpa staff or contracted by Simpa.

Timeline of Operations

TABLE 14: SIMPA TIMELINE OF OPERATIONS

Date	Activity
2010	Simpa Networks established in the USA with seed funding from Hilfiger Foundation. Arc Finance provided an initial grant of $40,000 to develop and test a prototype of the pre-paid meter.
2011	Initial pilots in Karnataka, India with SELCO. Selected as a Poptech Social Innovation Fellow.
2012	Received a US$750,000 grant from Doen Foundation to finance 1,000 customers. This was used as a revolving fund to finance 3,000 customers. Received Peer Entrepreneurs award of US$75,000 through Village Capital Investment at Dasra Social Impact Training Program.
2013	Received: • Technical assistance from International Finance Corporation under the Lighting Asia-India Program; • US$2 million equity investment from Asian Development Bank; and • US$968,000 USAID DIV grant to reach 12,000 customers. Also shifted business model to provide end-to-end distributed solar solutions and shift in geography to Uttar Pradesh.
2014	Raised US$4 million in debt equaling US$3 million from the Overseas Private Investment Corporation (OPIC) and US$1 million from GDF SUEZ' corporate social responsibility funds Receives technical assistance from REMMP for strengthening internal credit policies, as well as convening sector partner support and research on social impact.
2015	At the time of fieldwork, Simpa had reached over 14,065 customers equaling 13,565 in 1,500 villages across 8 districts in Uttar Pradesh and 500 in Karnataka. Recipient: OPIC Impact Award for excellence in International Development; World Wildlife Fund Climate Solver Award for their innovative business model; and Parivartan Award at the Sustainable Business Leadership Forum. Continues to work with REMMP.

Purposes of USAID Funding

Simpa received a $968,000 DIV grant from USAID in May 2013 in order to demonstrate the commercial viability of its PAYG model for distributed solar solutions and to assess the social impact of its innovation on the ground. Over a two-year period until May 2015, Simpa was to electrify 12,000 households and small to medium sized enterprises through direct sales of solar home systems (B2C model). A key feature of the grant was a built-in leveraging plan such that milestones could only be reached by Simpa obtaining additional debt or equity.

Simpa is also receiving in-kind support from ARC Finance under REMMP, which has been put primarily towards technical assistance for strengthening internal credit policies, networking and exposure visits, energy literacy programs for target customers and research on social impact.

Site Descriptions

With coordination help from Simpa, the review team opted to visit one of Simpa's older branches (nearly 18 months) in Aligarh District, Uttar Pradesh. Aligarh has a larger share of urban population at 33.1

percent in comparison to the state level at 22.3 percent. While agriculture is the primary economic activity in rural areas, Aligarh is an important commercial hub in North India known for its locks and bricks industries, as well as Hicks Thermometers. Aligarh, which is home to a prestigious academic institution, Aligarh Muslim University, is also recognized as a center for traditional and modern education in India. With household electrification at around 44.7 percent, in comparison to 38 percent at the state level, Aligarh (ranked 15 out of 70 districts) is one of the better districts in Uttar Pradesh in terms of household electrification.

Since the Urja Mitras (last mile sales agents) were key to Simpa's customer acquisition and growth within a specified geography, the review team visited locations that reflected a range of Urja Mitra activity from active to passive. The following villages, all of which were electrified communities with poor availability of supply, were visited:

- Palimukhimpur, Bijauli Block, Aligarh District, Uttar Pradesh: This community Urja Mitra has been with Simpa for four months and been a payment point for two months. He owns a medical shop at a major crossroad on the state highway, which offers several other services such as mobile phone recharge and internet recharge. He targets his pitch for Simpa systems to specific customers visiting his shop for other services and has sold 20 systems to date including purchasing one himself for the shop.
- Hardoi, Bijauli Block, Aligarh District, Uttar Pradesh: Community of approximately 1,100 households comprising of both Hindus and Muslims. This community's agent has been an Urja Mitra agent and payment point for nearly 18 months and has sold o/a 80 to 90 systems to households and shops to date. The Urja Mitra's brother is a contract technician for Simpa. Originally, the agent operated a battery business but is now mainly dealing with solar products, including Simpa's. In addition to this, the shop is also a cold drink center and offers mobile phone recharge. The review team also visited four Simpa customers in this community (two households and two shops).
- Attrauli, Bijauli Block, Aligarh District, Uttar Pradesh: Attrauli is a larger town in Aligarh district, with a population in excess of 50,000, that is central to several villages with Simpa customers. This Urja Mitra has been a payment point for nearly 18 months and has sold between 6 and 8 systems to date, including one for his previously existing shop. He is a payment point for 48 customers. He owns a medical shop at a major intersection point on the state highway and targets customers visiting his shop.
- Narona 12, Bijauli Block, Aligarh District, Uttar Pradesh: The Urja Mitra at this location was no longer operational but the review team visited a customer (eye doctor) who was a Simpa customer.

Implementation Specific Factors

Technology: a variety of solar home lighting solutions:

TABLE 15: SIMPA PRODUCT TECHNICAL SPECIFICATIONS

System	Solar PV Capacity (W)	Battery Capacity (Ah)	Load (DC)		Price (Rs.)
			Light	Fan	
Turbo 50	20	17	2/3/4 x 2.5W		14,000 – 16,000
Turbo 80	30	17	2/3 x 2.5W	1 x 10 W	16,500 – 17,500
Turbo 120	40	26	2/3 x 3W	1 x 15 W	18,500 – 19,500
Spark 40	40	40	4/5/6 x 2.5W	1 x 12 W	o/a 22,000

All systems have ½ USB mobile charging ports. Additional solar panels are sold to customers requiring a higher degree of service or desiring additional hours of operation. Unique aspects of Simpa include the meter and the back-end processing. They are able to track sales, installations, payments, ongoing customer relationship management and service tickets for each unit, which is a simplified version of the Salesforce solution and consists of a cloud-based revenue management system.

Target beneficiaries: lower- to middle-income households (Rs. 6,000 to 15,000 per month) living in un-electrified or poorly electrified communities in rural Uttar Pradesh. According to Simpa, these would be present in around 5 percent of the villages in the 8 districts of operation and approximately 1 percent of the households in each village, which are better off within their communities.

Payment methods: lease financing with a down payment of o/a 15 percent of the initial cost and a per day usage fee varying from Rs. 18 to 26, depending on the system size and combination. The per day fee decreases by Rs. 1 to 2 after the first 6 months. There are payment points located within a radius of 7 to 10 km, where customers can make payments and receive a code to unlock their systems for a specified number of days. As of now, customers need to recharge for a minimum of 10 days, with incentives for recharges of longer durations. There are also customer referral programs that offer benefits up to 10 days of recharge (Rs. 200) per referral. Customers can opt to buy out the system at the end of 6, 12, 18 or 24 months at differing values. The buyout price at the end of 6, 12 and 18 months is approximately 70, 55, and 40 percent, respectively, of the initial price.

Maintenance: since the systems are provided with lease financing, Simpa owns the systems until they are bought out by the customers. Simpa therefore has a strong field operations team, including contract technicians that are responsible for installation and maintenance of the system. Contract technicians undergo a three-day certification program before being deployed in the field; they are also provided support at the field level through experienced technicians. Contract technicians are provided with a standardized toolkit against a security deposit. There are typically two technicians per block and service calls are addressed within 48 hours of receipt of the complaint on the dedicated customer service helpline. The business model is predicated upon an average of two service calls per year during the time of the lease. Post-lease, when the customer buys out the system, Simpa offers a flexible payment plan covering 6, 12, 24, and 36 months. Customers are responsible for component replacement costs post-lease or post-warranty.

Method of planning: a baseline survey was carried out initially across the district to identify off-grid/underserved areas across different blocks. Customer acquisition is primarily through Urja Mitras, who operate on a commission basis (o/a Rs. 500 to 600 per system). Once a potential customer is identified by the Urja Mitra, (s)he is required to clear a credit appraisal process through a centralized team (including phone calls and household visits, if necessary) before being accepted as a customer. Standardized solutions with some variations on offer require minimal planning at the customer level.

Local community involvement: while there is no formal community engagement by Simpa staff, since the Urja Mitra/payment points/contract technicians are members of the local community, there is a degree of buy-in and comfort level for Simpa's solutions within the community. In instances where systems have been repossessed, Simpa has provided these systems free of cost to local schools in an effort to engage with and attract potential customers in the surrounding community.

Other: standardized training for Urja Mitras, contract technicians, and payment points; customer education on the use of the system provided by the technician at the time of installation and verified through a customer service call.

Other: a mixed enterprise financing model through (1) operational expenditure (e.g., wages, research and development, and branch expansion); (2) grants/equity investment; (3) capital expenditure (financing of

the systems) through long-term debt and short-term working capital (30 to 60 days line of credit) for supplier payments.

Initial challenges: at the strategic level, the key challenges were with respect to raising the necessary commercial capital for expansion and identifying and retaining good quality human resources at both the management and field levels. At the operational level, the company faced challenges due to rapid expansion on the ground without the requisite technical and payment collection support. Remote staff monitoring and management also posed challenges. At the customer level, the key challenge during customer acquisition was in communicating the link between high cost and quality. Once the customer is acquired, the challenge was in getting the customer to recharge for longer durations, which would lead to a positive impact on Simpa's portfolio health. In the event of customer default, there were some challenges in repossessing the systems from customers and, once repossessed, redeployment of the same.

Implementation Changes over Time

Simpa has evolved to cater to changing ground realities and customer needs. Major implementation changes include:

- Change of business model from incorporating the PAYG smart meters within solutions offered by existing energy access companies to offering end-to-end distributed solar solutions on a PAYG basis.
- In the context of the changing business model, Simpa changed geography from South India to North India, where the market opportunity (number of households without access to energy) is larger.
- Product development (manufacturing and testing) was initially in-house but has gradually been outsourced to suppliers in India and China. Simpa's focus is now on the continuous improvement of its cloud-based revenue management system through its in-house software development team.
- Simpa has strengthened its credit policy (through REMMP support) by increasing the down payment.
- Simpa focuses on increasing the density within existing areas to reduce operational costs in 2015 but is planning for rapid expansion in 2016.

Status at the End of USAID Investment

When USAID investment ended in May 2015, Simpa had reached the committed 12,000 customers. At the time of the review team's visit in August 2015, Simpa had reached 14,065 customers equaling 13,565 customers in 1,500 villages across 8 districts (branches) in Uttar Pradesh (Aligarh, Agra, Badaun, Bareilly, Hathras, Kasganj, Mathura and Pilibhit) and 500 customers in Karnataka.

Key Outcomes

Simpa increased access to electricity services (lighting, cooling, and mobile charging) for o/a 60,000 individuals across 1,500 villages (12,000 households assuming 5 people per household). For Simpa, USAID funding helped the company demonstrate the viability of its business model and establish a track record that attracted additional capital from several sources, including OPIC and GDF Suez, among others.

Outcomes Relating to Gender

Simpa received DIV funding to test its model at scale and did not have a specific gendered priority built into its milestones other than conducting an assessment of the value proposition posed to Simpa customers, and data would need to be disaggregated by gender. This evaluation was still ongoing at the time of data collection. Otherwise, the grant was designed to track and learn from business and process

indicators and build in a responsive management structure to facilitate later scaling using additional commercial financing.

Conclusions

Question 1: To what extent and under what conditions have USAID-supported decentralized energy systems been sustainable after USAID assistance ended?

Component 1a: Sustainability

Since this activity ended only in June 2015, it is difficult to examine its sustainability. However, the overall feedback on the performance of the systems and the maintenance services provided by Simpa, obtained through one-on-one discussions with the Urja Mitras, payment points and customers (households and shops), was positive. This was further corroborated in the midline evaluation carried out by an independent consultant on behalf of Simpa for USAID.

The systems observed were in good condition, which was expected given that the earliest installations are less than 18 months old. Men appeared to be generally more knowledgeable with the technology and operation than the women. However, customers were generally unfamiliar with the leasing arrangement, especially with respect to the buyout clause.

Customers were satisfied overall with the system performance, the usage charges and the response time in the event of a fault, although the last could be due to the presence of the Urja Mitra and the contract technician in the same village for one of the study sites. While the lights performed satisfactorily, there appeared to be some issues with the fan performance, especially during the monsoon season. Customers also indicated that the system was a good alternative to the main grid in comparison to an inverter since there was inadequate supply on the main grid to charge the inverter battery. However, customers expressed a need to power other appliances, especially televisions. Key benefits from the energy service highlighted by the customers were the ability for children to study and the improved quality of life due to reduced usage of unclean options such as kerosene lamps and candles.

The midline evaluation confirmed the above findings, with customers expressing satisfaction on the quality of light, affordable and flexible payments, hassle-free service at the doorstep, and impact on health. Customers also identified the inability to power other appliances and quality of service as the key areas for improvement. A significant proportion of the customers indicated that they would recommend this system to others.

There have been approximately 600 buyouts and 600 repossessions[18] to date. The average buyout time has been 18 months. Simpa has not been tracking the reasons for repossessions but anecdotal evidence points to a variety of reasons including misunderstandings regarding product/pricing, dissatisfaction, and "personal reasons." However, it is difficult to understand the trends with respect to buyouts and repossessions since the company has witnessed rapid growth over the past 12 months (10 percent month-on-month).

Urja Mitras also expressed satisfaction with the overall engagement with Simpa, including the support structures and the commissions per sale. However, the Simpa engagement was not a full-time activity for the Urja Mitras interviewed, given that they were engaged in alternate profitable activities. This is reflected in the percentage of active Urja Mitras across all branches, which was indicated to be approximately 33

[18] 600 repossessions from 12,000 clients represents roughly 5 percent.

percent (1,000 active Urja Mitras out of 3,000). Further, only around 400 Urja Mitras have sold a system over the past 6 months. This is again confirmed in the midline evaluation with most Urja Mitras operating from a fixed location (typically a shop) and seeing this as an activity to supplement their income and improve their relationship with existing customers.

Urja Mitras also reiterated customer demand for larger systems, especially to power televisions and other appliances, and for individual components, especially solar panels to charge their inverter batteries.

The company used different metrics to measure portfolio health, such as portfolio at risk - PAR 45/90. PAR 45 is 19 to 20 percent, which, according to the company, is considerably higher than for microfinance companies, and PAR 90 is 12 percent. Both measures are at the maximum permissible limits, and the company is introducing incentives and penalties to address this situation. However, the company has indicated that they are 5 percent ahead of target with respect to cash within the portfolio. While it is difficult to comment on this, the ability of the company to raise significant commercial debt, which has been extremely difficult for energy access companies in India, reflects a reasonably healthy portfolio.

TABLE 16: SIMPA SUSTAINABILITY MATRIX

Dimension of Sustainability	**Findings**	**Score** (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
System Production Capacity	Adequate for the stated service of lighting, cooling and mobile charging though customers indicated that the fan did not work during monsoon season.	2
Current System Condition	Systems are in good condition and appear to be well maintained.	2
Maintenance Capacity	Simpa owns the assets and provides prompt and hassle free service in the event of a fault; good feedback from beneficiaries.	3
Number of End Beneficiaries	12,000 customers at the end of the USAID investment; 14,065 customers at the time of the visit of the review team.	2
Capacity to Meet Beneficiary Needs	While beneficiaries are satisfied, they aspire for larger systems to cater to the entertainment needs.	2
TOTAL		11

Component 1b: Conditions for Sustainability

Simpa operates in an environment with significant competition from other solar home lighting solution providers (market-based as well as government schemes), mini-grids and the main grid. The competition from other market-based solar home lighting solution providers has decreased with the uncertainty around subsidies within the government scheme. However, the state government's procurement of 100,000 solar homes system to be distributed free of charge to low income households may dampen consumer interest. Over the next few years, the main threat could be from inverter suppliers, given that most Simpa systems appear to be functioning as back-up for the main grid, and their customer base has enough wealth to purchase and use inverters. While there is currently inadequate supply from the main grid to charge inverter batteries, improvements in quality of supply could improve the prospects for inverters. Moreover, any significant improvement of grid supply could obviate the need for Simpa's solar solutions or inverters. This threat is perceived as significant for companies such as Simpa that are operating without government support and finding a niche in providing a high-quality alternative to the failing grid. At the same time, interviews with national government officials, sectoral key informants, and officials at

the state level indicated such companies had a role to play in the medium term towards addressing the energy access challenge specific to Uttar Pradesh.

Simpa's solution is relatively expensive when compared to systems available through government schemes, given that there are no built-in subsidies within the business model, and the financing is more flexible and over a shorter duration. Despite this, Simpa has witnessed rapid growth (10 percent month on month) over the last year and aims to grow even faster over the next three years. A critical factor driving the long-term sustainability of Simpa is their ability to raise low-cost, long-term debt, as well as leverage donor funds. This can then lead to more affordable payments for the customers. Further availability of debt under those terms will be key for their strategy to increase the density from 1 to 5 percent in the areas that they are currently operating, which may in turn result in improved operational efficiencies.

TABLE 17: SIMPA SUSTAINABILITY FACTORS TABLE

Independent Variable	Impacts on whether outcome was sustained	Implications for future sustainability
Exogenous variables		
National policies	Have had some impact on the ground in terms of customer acquisition, especially with respect to communicating the link between cost and quality, given that Simpa customers cannot take advantage of subsidy.	Central government plans to eliminate subsidy for solar home systems is a positive; however, the Central government plans to achieve 100 percent grid electrification, and this could pose a threat, if achieved. State government procurement plans for over 100,000 solar home systems to be provided at no cost under the Lohia Awaas Yojana is a significant threat. Despite central government intentions on household electrification, it is unlikely that 100 percent household electrification is achievable in the medium term in Uttar Pradesh. However, availability of supply may again improve over the next year or so, given state assembly elections in 2017.
Macroeconomic conditions	Ability to leverage funds to access additional debt and equity critical to success	Continued access to financial markets will be necessary as Simpa expands
Socioeconomic conditions	Household electrification in Uttar Pradesh is still very low. Simpa customers are connected to the main grid but availability of supply is poor (2 to 3 hours per day except during election period) Target customers are low to middle income rural households who are energy poor but not necessarily income poor. Reasonable affordability levels given that they are able to meet Simpa's down payment and monthly usage fee levels.	Customer aspirations, especially to meet entertainment needs likely to be high and increase further in future. Will surrender the system if availability/quality of supply on the main grid improves.
Activity-specific variables		
Community engagement	Limited; operate through Urja Mitras within the village community.	If Simpa fails to develop solutions to meet increasing customer aspirations Urja Mitras' interest may decline.
Anchor institutions	n/a	n/a
Fee collection systems	Flexible payment options with easily accessible payment points are a plus. Challenges arise out of the flexible payment options with gaps in customer recharges as reflected in the portfolio health metrics.	Incentives for longer duration recharges and penalties for long gaps between recharge to improve portfolio health; low cost, long term debt in order to reduce the usage fees.
Maintenance systems	Installation and maintenance is done through trained in-house staff or contract technicians.	Maintenance processes are relatively strong, but access to and retention of skilled manpower pose a challenge.

Summary of Question 1 Conclusions

Simpa has been one of the few energy service companies in rural India that operates on a non-government subsidy-driven business model and has witnessed rapid growth in recent times. Simpa's success to date has been on account of its PAYG offering that caters to the energy needs of their target customers with flexible and affordable pricing combined with prompt and hassle-free service. A critical factor that may have contributed to their success is the flexibility available to the customers to either return the system or purchase it outright at specific points during the contract. The main threat to their business is in the increased availability of supply on the main grid, but reliable energy service provision through the main grid appears unlikely in the medium term. The key to Simpa's success is its ability to raise low-cost, long-term debt in order to finance its expansion plans and offer solutions at even lower usage fees to customers. Indeed, this was a key factor in being able to meet their DIV milestones. Another factor that will determine Simpa's future is their ability to develop and improve their offerings to meet the increasing aspiration levels of their customers.

Question 2: To what extent and under what conditions have USAID-supported decentralized energy systems been replicated or scaled up after USAID assistance ended?

Component 2a.1: Is there a secondary activity?

USAID assistance has ended only recently and it is therefore not possible to comment on the extent of scale-up or replication. However, in the period since USAID assistance ended, Simpa has reached an additional 2,065 customers in its existing areas of operation. While the focus for the current year is on consolidation and increasing densities in existing areas, Simpa has ambitious expansion plans over the next three years to reach a million customers. While ambitious, the plans would not require a significant increase in growth rate above the existing 10 percent per month rate Simpa has been experiencing. Maintaining that rate of growth over a longer period of time, however, could be a challenge.

Component 2a.2: How similar is the secondary activity to the original?

Simpa's scale-up plans are along similar lines to the original activity, with potentially lower usage fees if it is able to raise low-cost, long-term debt. Simpa is also planning to launch a new offering shortly, which will provide energy to power a television in addition to lighting, cooling, and mobile charging.

Component 2a.3: To what extent and how was the DE activity replicated or scaled up after assistance ended?

In addition to Simpa's expansion plans, companies like M-Kopa, which have successfully deployed energy solutions on a similar PAYG model in African markets, are exploring the possibility of entering the Indian market. Another Indian company, Green Light Planet, which has developed a smaller capacity solution that is offered on a PAYG basis in African markets, may also be looking to launch the solution in India.

TABLE 18: SIMPA REPLICATION & SCALING UP CHECKLIST

Type of scaling up	Description of observed approach(es)	Implications for sustained or continued replication
Replication	No replication in Indian markets. Companies with similar models in Africa exploring the Indian market	Increased competition may lead to cost reductions, which will benefit the customers. The key risk is from the government –

Type of scaling up	Description of observed approach(es)	Implications for sustained or continued replication
Expansion	Simpa has very aggressive expansion plans, which can only be met provided it is able to raise the necessary capital.	especially the state government given their recent procurement for over a 100,000 systems, which will be provided to customers at no cost.
Collaboration	N/A	N/A

Component 2b: Conditions for replication/scaling up

In the absence of an enabling policy and regulatory framework that clearly highlights the role of solar home systems and mini-grids within the context of the plans for expansion of the main grid, companies like Simpa will always face a threat. Recent trends with respect subsidy uncertainty for solar home lighting systems signals positive news for businesses like Simpa but against this, the large scale procurement of solar home systems at the state level to be distributed free of cost to customers threatens to destroy the solar home system market in Uttar Pradesh in the medium to long-term. In this event, Simpa may be forced to move forward if it plans to enter into new geographies such as Bihar, Chattisgarh, Jharkhand, and Orissa. Relaxation in the process of sourcing external debt for financing/leasing activities will also help significantly, although this is unlikely to occur in the near future, given the larger relevant issues.

Summary of Question 2 Conclusions

Given the recent uncertainty with respect to subsidies for solar home lighting systems, there appears to be a significant potential for scale-up and replication of the Simpa model across India in the medium term (five years). This assumes that companies are able to access low-cost, long-term debt in order to finance such expansion; as well as assuming the regulatory environment along with state support remains viable for commercial solutions. At current growth rates, Simpa reports 10 percent month on month expansion.

CASE STUDY SUMMARY 5: ORB ENERGY (CG)

Activity Overview

Orb Energy (Orb) is a private limited company established in 2006 that provides distributed solar PV and solar thermal (solar water heaters) solutions to residential, commercial and industrial customers across eight states in India. It caters to its market through a strong retail network with a major presence in Karnataka, Andhra Pradesh and Maharashtra. In addition, it also markets basic products such as solar lanterns and "plug and play" systems in domestic markets and international markets through partner organizations. Orb has recently established operations in Kenya in order to replicate its retail distribution model.

In 2013, Orb received support from USAID in the form of a portable credit guarantee that helped secure a loan from Deutsche Bank for backward integration within its solar water heating business line, the goal being to contribute to greater cost efficiencies. Although this Bangalore-based manufacturing facility was operational at the time of the review team's August 2015 visit, it was formally inaugurated in September 2015.

Orb sees the household demand for solar home lighting systems going down with the abeyance of the subsidy and the reluctance of banks to provide end-user financing. Orb therefore aims to focus on large

activities (both solar PV and solar thermal) catering to commercial and industrial customers, especially given the recent spurt in market activity in the roof-top solar PV sector.

Timeline of Operations

Date	Activity
2006	Orb was established in Singapore with investments from Cleantech Europe, Renewable Capital and the Singh Family and Operations in Karnataka.
2008	Received an award of US$1 million from the US State Department under the Asia Pacific Partnership on Clean Development and Climate; established 30 branches in Karnataka to date and aims to reach 60-70 branches by the end of 2015.
2011	Reached 25,000 customers through 90 branches spread across 4 states; Received US$1.1 million in equity investment from Acumen Fund to double the number of customers.
2012	Received an award of US$1 million as first runner-up in the SME/NGO category under the Zayed Future Energy Prize. Also received an equity investment of US$3 million from Bamboo Finance.
2013	50 percent portable credit guarantee up to $2 million under USAID's DCA (originally towards reaching its target of 500 branches). Established operations in Kenya.
2015	Equity Investment of US$2 million from the Netherlands Development Finance Company (FMO) towards replicating its retail distribution model in Kenya.
2015	At the time of the visit of the review team, Orb operated out of 140 branches (approximately 50 percent franchisees) and had an average monthly turnover of Rs. 5 Cr., of which 50 percent was through its solar thermal (water heaters) vertical.

Purposes of USAID Funding

Orb received a six-year, 50 percent portable credit guarantee from USAID in 2013 under the DCA mechanism in order to secure a loan of up to US$4 million. The objective of the credit guarantee was to support Orb in proving the commercial viability of its business model and establishing a strong track record, which would help secure debt financing in future from local financial institutions without a guarantee.

The guarantee was a revolving facility subject to an authorized amount of US$2 million (50 percent). With this support, Orb aimed to scale up its operations to establish 500 branches within 3 years (ending in 2016). Under this arrangement, Orb has thus far obtained a first tranche of US$1 million from Deutsche Bank for backward integration within its solar water heater vertical, i.e., towards setting up a manufacturing facility for solar water heaters with an eventual capacity of 1,500 systems per month (current capacity: 1,000 to 1,200 systems per month), which would result in greater cost efficiencies and improved margins.

Orb has been unable to secure a second tranche of a further US$1 million towards similar backward integration within its solar PV business line, despite the credit guarantee. This was due to Deutsche Bank's internal criteria, which limited the bank's exposure to one-third of the net assets of a firm, i.e., for the bank to lend US$2 million to Orb, it required Orb's net assets to be US$6 million as opposed to Orb's current US$4.9 million.

The credit guarantee was at no cost to Orb and has been extended twice.

Site Descriptions

Orb and the review team were unable to arrange specific site visits during the review team's time in Karnataka, in part due to the fact that Orb Energy's primary customer base are not rural households but rather commercial customers in both rural and urban areas.

Implementation Specific Factors

Technology: Solar PV Lanterns, Solar PV Plug and Play Systems, Solar PV Home Lighting Systems, Solar Water Heating Systems.

Target beneficiaries: Households, Commercial and Industrial customers. Recent focus has been more on the commercial and industrial customers to capitalize on the market opportunity for rooftop solar. Focus on the households/solar home lighting systems reducing due to uncertainty in subsidies and suspension of bank financing.

Payment methods: Cash sales and bank financing.

Maintenance: Maintenance services are provided through technicians at its 140 retail branches across eight states (approximately 50 percent of branches are franchisees). Customers receive two free preventive maintenance visits during the first year; with the first visit occurring within the first six weeks, which includes customer training on the use of the system.

Method of planning: Different systems are offered to meet the needs of individual customers and the ability to pay.

Local community involvement: There is no local community involvement.

Initial challenges: Solar PV is not competitive at the residential level and is further challenging due to the uncertainty in government subsidies and discontinuation of end user financing by banks. Raising enterprise financing has also been a challenge despite the credit guarantee.

Implementation Changes Over Time

- Although there is reference to Orb's plans on expanding its retail network to 500 branches by 2016 in the context of the DCA, the loan secured under this arrangement has been towards setting up a manufacturing facility for solar water heaters.
- The number of retail branches went up to 160 but stands currently at 140 and is expected to consolidate at around 130.
- The residential market for solar PV systems was seen to be uncompetitive. There are further challenges in this market due to uncertainty in subsidies and discontinuation of bank financing. The current focus is therefore on large activities catering to commercial and industrial customers.

Status at the End of USAID Investment

The USAID DCA guarantee has been extended twice and is still ongoing (through 2016). Orb has been able to secure a loan of US$1 million from Deutsche Bank through the guarantee in order to establish a manufacturing facility for solar water heaters.

Key Outcomes

Orb, to date, has received a US$1 million loan from Deutsche Bank for the purpose of establishing a manufacturing facility for solar water heaters with a capacity of 1,500 systems per month. The facility was

formally inaugurated in September 2015 and is expected to lead to significant cost efficiencies and therefore improved margins.

Outcomes Relating to Gender

There was no gender component or mandate required as part of the USAID backed portable credit guarantee.

Conclusions

The review team is unable to state any findings and conclusions regarding sustainability, scaling and replication given that the activity under consideration (use of DCA to finance solar PV system supply) has not been realized.

CROSS-CASE-LEVEL FINDINGS AND CONCLUSIONS

This report has presented five case studies, each representing varying technical approaches, stated core objectives, and degrees of success in sustaining outcomes and achieving scale. This section looks to the review's third research question and presents analysis across cases pertaining to effective models and processes in achieving sustainability and scale.

Question 3: What DE implementation models and processes have been most effective at achieving sustainability, scale, or replication?

To guide this section, the report consolidates the various factors supporting sustainability, scale, and replication into three frames of analysis described in the Methodology section:

1. Contextual;
2. Technical approach; and
3. Implementation factors.

Contextual Factors

Among contextual factors contributing to sustained outcomes and scaling, three categories were prominent across cases:

1. National and sub-national level government policies regarding both grid expansion and support for DE;
2. Macroeconomic factors related to access to finance for DE; and
3. Socioeconomic factors.

Each of these is addressed below and summarized for each case in Table 19.

Policies and Regulations

A policy area that has created uncertainty about the future of DE in India is the status of the grid, both in its extent and its reliability. This is an issue of both fact and perception. The grid is currently not available to large portions of the Indian population, particularly in rural areas, and is often highly unreliable even where it is available. Furthermore, the grid can be expensive to extend and may not always match the actual demand for electricity (i.e., households may not always require the level of power a grid can theoretically offer). DE options can provide a solution for areas where the grid cannot reach, is an inferior

solution, or is unreliable. Both commercial and non-commercial (i.e., development-oriented) initiatives have provided solutions in this space. DE in India therefore can serve as both the primary provider of electricity, or as a grid backup/supplement in areas with present but unreliable grid-access (as was the case for various sites visited in Uttar Pradesh among Case Studies 1, 2, and 4).

A reliable and subsidized grid is hard to compete with for commercially oriented DE solutions and obviates the need for non-commercial DE solutions. However, the pace of grid expansion and the provision of reliable power may not meet the ambitious targets currently being set in India if history is any indication. The policies and promises, however, raise a number of questions and concerns (expressed by a variety of interviewees including those at the activity level as well as key informants at the sectoral level). Uncertainties include:

- How does the promise of the grid impact customers' willingness to pay for DE solutions?
- What will happen to investments in capital once the grid arrives in an area already served by a DE solution?
- Will there be a regulatory mechanism to integrate micro-grids into the existing grid system?

In part as a result of the renewed focus on expanding the grid, the level and kind of support for DE appears to be in a state of flux and uncertainty at the moment. Conversely, there are programs that are providing solar solutions for free to low-income households (e.g., in Uttar Pradesh). In some cases, this might directly eat into the customer base of commercial DE solutions. In other cases, while those households may never have become customers, other households may question the cost of service when their neighbors are receiving the technology for free.

Together, this policy environment is creating challenges for expansion of DE at a time when there are significant advances in DE technology and business pathways. There are two challenges in particular to highlight: (1) the effect of subsidies, policies, and regulations on the development of DE-centric business models, and (2) the effect of these policy mechanisms on the development of a viable ecosystem to support commercial DE, including in the financial sector, discussed below. Interviewees raised policy, regulatory reform, and enabling environment support as areas where donor agencies are well placed to influence the evolution of the industry.

Macroeconomic Conditions

Repeated interviews with sectoral and case-level informants indicate that in addition to the policy issues outlined above, one of the main challenges facing the sector is access to capital. Three themes emerged from interviews conducted as part of this review's research in India:

1. The financial sector in India was generally unfamiliar with DE activities and therefore actors were reluctant to lend money due to their own difficulty in assessing risk.
2. Indian financial institutions follow a model of balance sheet financing for commercial lending rather than project financing or require some form of collateral. Commercial DE start-up companies cannot show a balance sheet history or the collateral that would qualify them for loans.
3. The expected rates of return and the lending terms often do not fit with the current state of the DE market.

A number of interviewees at the sectoral level, as well as key informants from the commercial enterprise cases (Case Studies 1, 4, and 5) saw this as an area of support from donor agencies that would be catalytic in moving the entire sector forward. Ideas included both capacity building for financial sector institutions as well as mechanisms to reduce risk and change lending terms.

Socioeconomic Factors

Socioeconomic factors play a complex role in uptake and diffusion of DE technologies. Two key factors that can be highlighted from the Indian activities are the targeting of different market segments and the use of community groups to make even very small transactions at the individual level attractive to commercial actors. The formation of customer groups was important for at least two of the activities (MGP and HPPI) but in very different ways. For HPPI, the women's self-help groups acted as a solid foundation for the solar lantern customer base (and the entrepreneur was selected from within the group) and further served to catalyze HPPI's social development objectives for women's empowerment. MGP, on the other hand, used groups in a much more direct way. While HPPI solar lantern renters could come from the group but did not necessarily have to, only customers in a group could get power from MGP's offering (based on the fee collection structure preferred by MGP). Furthermore, paralleling the micro-finance model, MGP used the group as a guarantor for any individual in the group.

TABLE 19: CONTEXTUAL FACTORS CONTRIBUTING TO SUSTAINABILITY, SCALABILITY AND REPLICABILITY FOR DE IN INDIA

Context Factors	MGP (ES)	HPPI (DD)	SSP (STA)	Simpa (ES)	ORB (CG)	Country-level Conclusions
Policies - Grid expansion	Low-cost grid alternative; Grid expansion would reduce market	n/a	Grid expansion would reduce market but solar only one of basket of products offered	Act as grid backup – grid improvement would reduce market	Grid expansion and improvement could hamper their off-grid market	Clarity on grid expansion and incorporation of existing DE needed
Policies – DE Support	Free solar home systems undercut market	n/a	n/a	Free solar home systems undercut market	n/a	Clarity on DE support and market enhancing public support needed
Macroeconomic conditions: poor lending conditions	Requires access to capital for expansion	Non-commercial activity; not seeking private capital	Non-commercial activity; Not seeking private capital	Requires long-term low cost debt for business model to be viable	Difficulty even with DCA to finalize solar loan	Capacity building, risk mitigation and lending sector transformation needed
Socioeconomic conditions	Relies on formation of groups	Relies on creation of self-help groups to further other HPPI objectives	Tied to creation of entrepreneurs supported by village heads	Targeting of small % of households with ability to pay	n/a	n/a
Activity-level Conclusions	Company sustainable but faces policy and risks and difficulty obtaining capital	Not sustained as solar charging stations and lanterns failing over time	Emphasis on entrepreneur creation; Not limited to solar offerings	Sustainable model with strong growth plans but facing some risks	n/a	n/a

Technical Approach Factors

India provides an instructive portfolio in its own right because each of USAID's main investment/technical approach modalities are represented. Support for the DE sector has included CG, ES, DD, and STA support.

The Orb Energy Case (Case Study 5) saw a private enterprise access a USAID partial guarantee for a commercial loan. Orb sought financing to expand two different business lines (one for solar water heating and the other for solar PV). While Orb was successful in the former, it to date has been unable to use the other half of its portable CG for solar PV. The issue was the firm's inability to meet all the requirements of the lender (Deutsche Bank). It was Orb's opinion that greater involvement by USAID may have resulted in greater flexibility from the lender; however, this was offered merely as speculation.

The two ES grant recipients (MGP and Simpa) on the other hand appeared to be successful in leveraging their grants to obtain additional commercial-financing. In both cases, USAID-DIV funding was credited with helping prove the case of their business model to other funding sources. In addition, MGP and Simpa appear to be the two cases that best achieved scale and are well placed to continue their expansion, depending on public policy considerations.

HPPI (DD) and SSP (STA) support had mixed success. Notably these two cases were NGO driven models that did not place for-profit commercial interests at the center of their core-objectives. Neither HPPI nor SSP appear to be sustainable or scalable under current conditions. However, both have arguably been successful across other metrics. HPPI views itself as a provider of clean energy lighting in the areas where they operate, and the self-help groups provided positive contributions in their own right (due to the group savings component). According to HPPI, this joint clean energy/social entrepreneurship/women's empowerment model creates positive reinforcement for all three priorities. Interviews conducted by the review team corroborate this; however, the solar lanterns donated in 2009 are breaking down and there is no mechanism for replacing them. Similarly, SSP which endeavored to support female entrepreneurs and clean energy technology value chains looks as though it will struggle to maintain operations once donor support is removed, despite its success in bringing a variety of important products to underserved communities (e.g., cleaner cook stoves and improved toilets in addition to basic lighting).

Implementation-Specific factors

An examination across all of the activities studied in India suggests that there are a few key areas that DE implementers need to focus on to be sustainable and replicable, but significant variation across the activities indicates a wide range of possible approaches can be made sustainable and scalable.

There was significant variation among the activities in how to achieve their goals and even whether sustainability and replicability were the end-goals they were seeking. For HPPI and SSP, while sustainability of the implementation was important, the focus of the activity was also on creating and/or strengthening their community engagement and other programming through self-help groups and entrepreneur development. These NGOs have a broader objective and are not tied to the success or failure of their DE implementation over the long term as is the case with commercially oriented DE solutions, such as MGP or Simpa.

The various cases also demonstrate the diversity of commercial pathways that can be employed when disseminating DE technologies. Each utilized a variety of fee structures and fee collection mechanisms and was tied to the particular implementation strategy dependent on the technology chosen. This appears tied to a broader strategy of tailoring the offering for a particular consumer segment and then implementing for that segment. This necessarily involves tradeoffs in service levels and is tied to technology choices as can be seen in Table 20.

TABLE 20: DIVERSITY OF BUSINESS OPERATIONS ACROSS CASES

Activity	Technology	Payment Mechanism
MGP	Small-scale solar micro-grid	Low regular payments
Simpa	Large single home systems	Leasing
W-Power-SSP	Large single home systems	Purchase
HPPI	Small single home systems	Rental

In contrast to DE relevant literature,[19] community engagement appeared to be of mixed importance for the Indian activities but this may be explained by the type of activity (commercial vs. non-commercial). Simpa, arguably, has the lowest level of community engagement as it is based upon a dealer model where it identifies and recruits a single entrepreneur. MGP ostensibly has a community engagement component in that the micro-grid customers are part of a self-selected group. However, the group exists solely to ensure sufficient customer base and to facilitate payment compliance. By contrast, HPPI explicitly formed multiple self-help groups that were catalyzed by the solar lantern rental opportunity but had a broader mandate. SSP worked with local leaders to identify and recruit entrepreneurs but also attempted to engage the community more broadly through education (e.g., the clean energy hub).

Consistent with the literature,[20] a well-functioning and responsive maintenance system that is supported financially within the business model is important for sustainability and eventual scalability and replicability. All four of the implemented activities (Orb not being applicable) recognized the need for maintenance and created a maintenance support system for their technology. However, the ability to maintain the systems over time varied and can reasonably be expected to vary into the future. MGP and Simpa, as commercial enterprises that own their hardware (at least until buy-out in Simpa's case) have a very strong incentive to maintain systems in order to ensure proper operations and continued revenue. Their structure is designed to incorporate maintenance into the customer's standard fee, and they have trained personnel and a commitment to quick service. Feedback on maintenance processes for MGP and Simpa was favorable. HPPI and SSP also had maintenance personnel and processes in place. However, it appears that the funding of the maintenance system was insufficient in the case of HPPI and was included in the soft costs of the implementation that was supported through donor funds. The end of donor funding then creates a problem for ongoing maintenance. Feedback on SSP maintenance was generally positive, though issues with delays in service due to lack of local technicians led to further training for the Sakhis to do minor maintenance. The review team notes that this activity has just ended and it is difficult to judge performance over the longer term.

Another factor that emerged across the activities was the human capital requirements for successful implementation. This included finding entrepreneurs or dealers (e.g., Simpa, HPPI, and SSP), maintenance personnel (all), and collection agents (MGP). Processes for identifying, training, and retaining candidates appeared to have evolved in many cases during the course of the implementation. This may partly be a function of scaling as implementations began to reach more beneficiaries across a larger geography but also appears to be in response to challenges arising during the course of implementation.

[19] See: Brass et al (2012) and Mansuri and Rao (2004, 2013).
[20] See: Bazilian, et al (2012), Brass et al (2012), Sovacool (2012, 2013), and Terrapon-Pfaff (2014).

TABLE 21: IMPLEMENTATION FACTORS CONTRIBUTING TO SUSTAINABILITY AND SCALABILITY

Implementation Factors	MGP	SIMPA	SSP	HPPI	Country-Level Conclusions
Community engagement	Rely on self-formed consumer groups; can create community exclusion	No community engagement; operate through local dealer network	Community engagement with village leaders to identify entrepreneur	Strong community engagement through self-help groups	A range of approaches, not all relying on strong community engagement
Strategies for collecting fees	Group responsibility	Pay-as-you-go implemented through technology	Sales	Rental	Variety of fee collection mechanisms possible
Systems for maintenance	In-house maintenance teams	In-house maintenance teams	Maintenance person for cluster of entrepreneurs	Subsidized maintenance person for cluster of entrepreneurs – insufficient maintenance	Strong maintenance system needed for sustainability
Other: End-user affordability	Low-cost micro-grid with service fee	Service fee that pays down system cost for purchase	Multiple offerings at different price points	Low daily fee rental service	Sustainable activities target certain groups and make service levels and costs appropriate
Activity-level Conclusions	Activity has been sustainable and growing. Will likely continue to grow.	Activity has been sustainable and growing. Will likely continue to grow.	Activity not be sustainable without continued soft funds	Activity not sustained over time. Service levels will continue to decline.	n/a

Findings Regarding Gender Equality and Women's Empowerment

Two themes can be compared across the cases examined for this report relating to women's empowerment or gendered aspects of DE access:

1. Inclusion of women within the implementation model; and
2. Explicit use of energy as a vehicle for women's empowerment and livelihood improvement.

To recap, cases such as MGP and Simpa provided electricity benefits to each household with little explicit regard for gender. However, per MGP's reports, there did seem to be equal benefit, including for women-run small business. The NGO-driven activities, with their clear and explicit focus on women's empowerment, ensured that electricity benefits were realized by women as much as men.

Points one and two above illustrate differences between the implementations. The broader mandate of HPPI and SSP mean that they not only focused on gender in terms of use of electricity but also on creating and sustaining female entrepreneurs. This can be contrasted with MGP's initial attempts to utilize women's groups for payment handling. As a commercial actor, MGP adapted a different solution when early

attempts to collect service fees through women's groups proved problematic. This adaptability would not have been an option for SSP or HPPI because the women's groups were central to their investment.

However, the differing approaches to gender and the differences in outcomes among the India implementations raises a conundrum in terms of the existing dichotomy of NGO-led versus commercial projects. Those implementations most concerned with ensuring gender equity and using energy for empowerment of women were either not sustainable (HPPI) or have sustainability challenges (SSP) that deserve reflection. By not creating a business model that could sustain itself, they remain reliant on soft funds. On the other hand, the sustainable and scalable cases are those that have a more commercial focus and whose gender contributions are notable; however, not targeted. That is, the impact that MGP or Simpa have on women is the result of the access to electricity they provide at the household or community level.

One possible implication is that the NGO-based activities that focused on women's empowerment should perhaps not be seen as DE activities. Rather, they could be seen as gender empowerment activities that use DE as a vehicle for meeting broader needs. In that case, DE is a tool to accomplish other goals. If the latter, then the lack of sustainability might be unfortunate, but not as critical a concern if other objectives were being met.

Another implication is that alternative approaches can be explored that incorporate an explicit gender focus with commercial approaches that seek sustainability and scale. It may also be reasonable to find mechanisms to make direct delivery projects more sustainable, for example through highly-targeted business model development support.

INDIA-SPECIFIC RECOMMENDATIONS

The purpose of this portfolio review is to provide actionable recommendations across the whole of USAID's DE portfolio. However, the review team provides a few India-specific recommendations based on the five cases examined as part its India based case study research.

1) **USAID should continue its DE technical support and capacity building activities in India.**

   Based on sectoral key-informant suggestions[21] made during interviews, USAID should continue its electric power sector technical support and capacity building activities in India. These activities should be continuously reviewed to ensure they support the development of new policies and regulations that are geared towards reducing the risk and uncertainty around DE and foster a more favorable financial environment for commercial actors like MGP and Simpa that have achieved remarkable success in scaling their operations.

2) **USAID should review the linkages between its complimentary DE and gender equality and female empowerment objectives. These objectives are complimentary; however, greater coordination and integration could improve the likelihood of sustained outcomes and achievement of scale for either.**

   Because USAID supports multiple development objectives and prioritizes poverty reduction and gender equality, the Agency should review its criteria for supporting DE systems and adopt pathways to better integrate empowerment and equity goals with sustainability and scale objectives for its DE

[21] Including government, NGO, banking, and commercial enterprise respondents.

programs. These goals are complementary and may enhance the popularity, profitability, and sustainability of DE systems. USAID could play a key role in helping commercial enterprises explore DE products that meet gender differentiated energy needs and payment methods

3) **USAID should utilize criteria for DE support that includes the formal development and review of a business plan in order to catalyze a sustainable source of funding following the end of donor support.**

   For future DE direct delivery-type investments, USAID should develop screening tools to ensure that interventions the Agency supports have either a business plan or maintenance structure that can service and/or replace installations absent of continued donor support.

ANNEX A: REFERENCES

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