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COUNTRY REPORT AND CASE STUDY SUMMARIES – TANZANIA

DECENTRALIZED ENERGY PORTFOLIO REVIEW

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COVER PHOTO

Caption: Mwanza District, Tanzania. EGG-Energy and Mobisol partnered to facilitate EGG's smart-applications allowing for remote solar system monitoring.

Credit: Ryan Thomas, MSI

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DECENTRALIZED ENERGY PORTFOLIO REVIEW

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E3 Analytics and Evaluation Project

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ACRONYMS

CDCS	Country Development Cooperation Strategy
CG	Credit Guarantee
DE	Decentralized Energy
DCA	Development Credit Authority
DD	Direct Delivery
DEC	Development Experience Clearinghouse (USAID)
DIV	Development Innovation Ventures
DV	Dependent Variable
dTS	Development and Training Services Inc.
E3	Bureau for Economic Growth, Education and Environment (USAID)
EGG-Energy	Engineering Global Growth-Energy
ES	Enterprise Support
E&I	Office of Energy and Infrastructure (USAID/E3)
FENERCA	Increased Use of Renewable Energy Resources Program (Financiamiento de Empresas Energéticas en Centroamérica)
GSM	Global System for Mobile Communications
IDI	In-depth Interviews
IV	Independent Variable
KII	Key Informant Interview
kWh	Kilowatt Hour
MEM	Tanzanian Ministry of Energy and Minerals
MMEE	Mona-Mwanza Electrical & Electronics
MSI	Management Systems International
MW	Megawatt
PAYG	Pay As You Go
PEP	Persistent Energy Partners
PV	Photovoltaic
REA	Rural Energy Agency
SHS	Solar Home System
SIDA	Swedish International Development Cooperation Agency
SOW	Statement of Work
STA	Sectoral Technical Assistance
TANESCO	Tanzania Electric Supply Company Limited
TEDAP	Tanzania Energy Development and Access Project
Tshs	Tanzanian Shillings
UNDP	United Nations Development Program
USAID	United States Agency for International Development
USG	United States Government
VETA	Vocational Education and Training Authority
Wp	Watt-Peak

EXECUTIVE SUMMARY

Portfolio Review of USAID Decentralized Energy Activities

This document presents and compares three Tanzanian case studies that inform a wider portfolio review of USAID decentralized energy (DE) investments that 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: Tanzania, Brazil and India. Therefore, primary data were 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 3 Tanzania 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 three 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 Tanzania

Tanzania has low rates of electricity access, particularly in rural areas. While roughly 20 percent of Tanzanians have access to electricity, only 3 percent of rural Tanzanians have grid connections. Grid extension has been a priority for Tanzania's Rural Energy Agency (REA), and in recent years REA has extended the grid to hospitals, clinics and schools in rural areas, with plans to connect a larger number of households to the grid over the next few years. Currently, grid connections are unavailable or unaffordable for most rural Tanzanians and a growing number of off-grid energy companies have begun to market energy services to rural Tanzanians. Each case study profiled in this report markets its products to a different income-group. This range first illustrates the ubiquity of energy poverty in rural Tanzania, but these cases also provide instructive lessons for expanding energy access to a broad base of rural residents.

USAID-DE Investments in Tanzania

Tanzania hosted only 1 of the 31 distinct activities that make up the review's inventory; however, 2 additional investments were included as case studies due to their comparability with contexts and themes exhibited elsewhere in the portfolio.

The activity formally included in the wider portfolio was a DIV grant in 2012 to Engineering Global Growth (EGG) – Energy. EGG serves as Case Study 2 in this report and is discussed below.

The other two cases, Off-Grid Electric/M-Power and Zara Solar, also provide instructive lessons. Off-Grid Electric/M-Power received a DIV grant in 2013 but has been operating in Tanzania since 2011. Zara Solar, on the other hand, received support from the USAID FENERCA[3] activity. FENERCA was a USAID cooperative agreement held by E+Co initiated in 2000 and ended in 2005. FENERCA's objective was to promote the development of renewable energy enterprises and projects, while increasing the capacity of financial institutions, entrepreneurs, and NGOs. FENERCA operated mainly in Latin America but was later expanded to Sub-Saharan Africa, including Tanzania. While this global STA investment is not included in the review's formal inventory, it extended loans to Tanzanian firm Zara Solar which is included as a Case Study 1 and discussed below.

[3] Increased Use of Renewable Energy Resources Program – (Financiamiento de Empresas Energéticas en Centroamérica) (Award #: LAG-A-00-00-00008-00)

USAID Investments Selected as Cases

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 5. All of the cases represent ES-type investments.

Case Study 1 – Zara Solar/Mona-Mwanza Electrical and Electronics (MMEE): Zara Solar is related to the older company Mona-Mwanza Electrical and Electronics (MMEE). MMEE/Zara received three loans from FENERCA's implementer E+Co[4] in 2001, 2004, and 2005 to build its expertise and offerings in the solar market. Starting in 2000, MMEE became increasingly interested in selling solar home systems and began working with solar experts in East Africa, including E+Co. The 2001 loan of $50,000 allowed MMEE to expand its retail business to include solar PV systems. E+Co provided technical assistance to help MMEE complete a business plan and in 2004 disbursed a second loan for $100,000. The second loan enabled MMEE to purchase solar PV components in bulk. As a condition of the third loan ($200,000), MMEE split its operations into two; opening Zara Solar, Ltd. MMEE/Zara maintained the same owner, location, and business model, but Zara exclusively provided customers with high-quality solar PV systems targeted to relatively well-off rural residents of the Mwanza region.

Conclusions: The review team found Zara to be the most successful in terms of sustainability among the three cases. A major contributing factor to Zara's sustainability is its strategic partnerships with a Tanzanian Government-UNDP collaboration that trains solar technicians and maintenance workers in the region. At least in part due to the solar training scheme, the region enjoys a sophisticated understanding of solar products, which supports demand for Zara's offerings and allows savvy consumers to easily tap into technician networks to maintain purchased systems. Zara's upfront pricing reduces risk and financing costs for the company, but also limits its customer base to those who can afford the system in full. Zara's systems provide sufficient power to meet household needs for lighting and television and can support small-scale entrepreneurial activity. The firm has experienced substantial growth in recent years; although it has not expanded beyond the Mwanza Region. Because of Zara's business model, strategic partnerships, and Mwanza's structural advantages, the review team speculates that scaling the firm's offering outside of Zara's home region would require significant adaptation.

Case Study 2 – Engineering Global Growth-Energy (EGG-Energy): EGG-Energy is a commercial firm providing energy services to rural Tanzanians. Founded in 2009, EGG's original offering was solar powered battery-charging hubs. In 2012, EGG received a $100,000 DIV grant in 2012 to test the viability of this model. Over the course of this grant period, EGG recognized that its hub approach to disseminating energy services was found to be inconvenient by customers. The firm then switched its focus to rent-to-own solar systems for household/small business use (systems generating between 50 and 200Wp). EGG also tapped into agriculture networks as a key customer outreach tool when it switched its operations away from its base in Iringa, towards Tanga. The 2013 DIV grant (also $100,000) was provided to improve EGG's data infrastructure, which linked mobile money systems with the company's customer service records; developed data applications to track logistics, inventory, and customer management; and trained staff to use new software systems.

[4] E+Co faced liquidation in 2012 due to unpaid loans and its Africa operations were restructured as Persistent Energy Partners, a for-profit energy company operating in Ghana and Tanzania.

Conclusions: USAID support for EGG-Energy has only recently ended; however, the adaptability of the firm provides instructive lessons in flexible commercial approaches to DE programming. EGG's original battery-charging hubs remain operational, but exposed the firm to non-payment risks which became evident early in the 2012 grant's implementation. The revised approach will likely be more sustainable based on several promising improvements: (1) EGG provides financing options to customers based on a rent-to-own scheme, widening its customer base and encouraging customers to payoff systems instead of losing accumulated equity. (2) EGG now uses Global System for Mobile Communication (GSM) applications to switch off systems that have outstanding payments. This reduces the need to repossess units unless payment remains delinquent for extended, and un-communicated, periods (EGG is flexible with seasonal workers with unsteady incomes). (3) Partnerships with agricultural organizations have shown to be a successful way to market offerings to target customers and conduct basic customer-credit inquiries. This report concludes that EGG's model has the potential to scale; however, EGG employees claimed that poor access to capital is a constraint on the firm's growth. Staff also stated that USAID early-support has been instrumental in attracting the financing the firm has been able to secure. Further, EGG's model requires a critical mass of customer penetration in any given region to make viable its O&M model; making rapid expansion to new regions challenging. Grid expansion also poses a medium to long-term challenge; EGG's CEO stated that grid-connected customers typically remain interested in off-grid solutions due to reliability concerns; yet, nonpayment is more common within this demographic.

Case Study 3 – M-Power (Off-Grid:Electric): Off-Grid:Electric, known in Tanzania as M-Power, is a clean-energy start-up that began selling low-cost lighting and cellphone charging services at prices competitive with kerosene. The firm's Tanzanian offshoot was founded in 2011 and uses Arusha as its base of operations. The company has since expanded with offices in 11 districts throughout Tanzania. M-Power's basic systems feature three lights and a mobile phone charger and costs users approximately $1.25 per week. M-Power has received two USAID DIV grants. The first in 2013 was for $100,000 and assisted with operating costs and was meant to facilitate company growth from roughly 500 installations to 1,500 installations. The second, in 2014, also for $100,000, was designed to test the firm's model at scale in new locations and with new approaches to agent training and compensation. While USAID's first investment in M-Power is outside of the review's 2004 to 2012 period of interest, it was selected because M-Power's founding date was several years prior and was recognized from desk review as the most successful case to achieve scale within the Tanzania portfolio.

Conclusions: At the time of the review team's visit, M-Power reports having installed over 60,000 systems with a repossession rate of approximately three to four percent. A key component of M-Power's success is that it has been able to provide an offering that is competitive with kerosene and uses advanced software systems to track company performance and customer usage statistics. The firm has created a four-week academy that trains potential M-Power employees in basic business practices and M-Power's technical offerings. This training program has allowed M-Power to staff its rapidly growing number of offices spread out over 11 districts in Tanzania. A customer compliant is that M-Power uses a fee-for-service approach with no option for customer buyout of the system. Grid expansion poses risks because low-usage customers (those using less than 50kWh per month), are eligible to receive a subsidy from the national utility that would effectively offer low-quantities of energy at a third of M-Power's weekly rate. Accessing this subsidy of course requires the grid's presence in one's community (and $20 connection fee). For households consuming more than 50kWh, M-Power's offering remains competitive; although M-Power's services typically cater to basic needs. Despite these medium to long-term challenges, M-Power has achieved a remarkable degree of beneficiary and geographic coverage and shows strong potential to sustain its operations it if is able to adapt to Tanzania's rapidly changing set of regulatory and economic contexts.

Cross-Case Conclusions

Policy/Regulatory Uncertainty

In Tanzania, the expansion of the grid, especially close to major population centers in the near and medium-term, has the potential to reduce commercial DE company sales through the gradual shrinking of the customer base. This is especially true for firms that could compete directly with the grid. Interviews with Zara Solar and EGG indicate that grid extension contributes to either a drop in sales or increased periods of nonpayment. This suggests that Zara and EGG's higher-end products may compete directly with the grid; whereas M-Power's lower-cost offerings target customers who likely would be unable to afford the grid's current upfront connection fee, or would be unable to utilize the current low-user subsidy. These policies are subject to change however.

Based on the three case studies, this report concludes that commercial DE actors that find ways to compliment or accommodate grid expansion, or are flexible enough to change service territories when the grid expands, will be better positioned to provide sustainable access to electricity while remaining financially viable.

Access to Capital

Macroeconomic conditions, particularly access to capital, affected all three firms. All reported that access to capital was crucial for growth and expansion, but found that lenders perceive their businesses as high-risk. Zara Solar found that an influx of capital early on in its solar PV venture was sufficient. EGG and M-Power, however, require continued financing to (1) provide flexible payment options to their customers and (2) fund new offices and floor space. M-Power has received sufficient investment funding and grants to open 10 new offices in the past year and a half; EGG plans to expand to new regions once it obtains sufficient investment funds. Both EGG and M-Power noted that early USAID-DIV funding was crucial in attracting additional financing from donors and private investors; however, domestic debt is difficult to attract. This is at least in part due to the finance sector's unfamiliarity with start-ups employing innovative business models, especially those using relatively new DE technologies.

Community Engagement

The Tanzanian cases profiled in this report worked within or grafted themselves onto existing community structures in innovative ways. Zara Solar was able to greatly increase its customer count by capitalizing on other donor support mechanisms, specifically a partnership between the Ministry of Energy and Minerals and the UNDP. The UNDP-MEM program has contributed to a relatively sophisticated regional user base in terms of solar technology near Mwanza. This in turn has increased demand for Zara's products and established a large pool of qualified technicians to maintain the systems. In this environment, Zara has achieved deep penetration into the regional market; but reliance on this structural advantage limits Zara's ability to replicate elsewhere.

EGG on the other hand uses community agriculture associations to market its products. This marketing serves two purposes: first, EGG is introduced to a whole network of potential users; and second, these associations are seen as a good way to attract clients with sufficient means to make regular payments. Somewhat similarly, M-Power tends to train and hire local employees across its large and growing number of outlets in order to utilize staff's intimate knowledge of target regions and communities.

Between these cases, this report concludes that knowing one's customer and the context in which they plan to consume energy is helpful for commercial approaches to scale. Yet, sustaining systems has more to do with building (or tapping into) O&M procedures that responds to customer maintenance needs and is flexible enough to adapt to changing circumstances.

Fee Collection and Maintenance

Each of the cases presented in this report developed fee-collection strategies that mitigated the risk of nonpayment. Zara represents the highest-end product offering of the three. The firm targets customers of sufficient means to pay upfront installation costs which is out of reach for a wide range of rural residents. In turn, Zara's financial risk is quite low and local technicians provide routine maintenance at reasonable fees contracted by the customer. EGG provides a two-year warranty and the firm continues to own the system as customers pay a regular fee. The fee is designed as a rent-to-own payment resulting in the eventual cessation of payments, which customers found advantageous. EGG mitigates risk by using GSM-based applications able to switch off installation generating capacity in the event of non-payment. For short term non-payment this makes repossession unnecessary and contributes to system maintenance monitoring. Customers generally found EGG's two-year warranty to be well implemented. M-Power on the other hand provides a fee-for-service model and maintains ownership of the installation indefinitely. Customers appreciate the affordability of M-Power's systems; however, would prefer to be able to gradually purchase it outright. At least in part to M-Power's rapid expansion, customers reported delays in receiving system maintenance.

Gender Empowerment

USAID's investments in the three cases profiled in this report were supportive of existing enterprises and thus were not designed to specifically address gender inequities. That said, extending energy access naturally has the potential contribute to gender empowerment. Across the cases, end-user interviews confirmed that energy needs differ between men and women, and low-capacity solar home systems are of limited benefit to females. Near the sites visited by the review team, the team found that men typically make decisions about where lights will be placed (low-end systems only support two to three lights) and rarely locate them in the kitchen, where women would benefit most. Relatedly, female respondents expressed interest in energy generation for ironing, cooking, and refrigeration, which require larger (and more expensive) solar power systems. Despite a greater overall need for electricity, women in the sites visited by the review team were commonly excluded from decision-making about energy systems and often expressed limited understanding of how the systems work. Although there were instructive exceptions.

During one set of interviews with Zara Solar beneficiaries in Sengerema, and during another set of interviews with EGG customers in Tungalamenga, the review team spoke to multiple female beneficiaries who were the primary users of their systems. These women expressed sophisticated understanding of their system's capacity and maintenance needs. In both cases, this higher-than-normal level of familiarity seemed to be a combined function of favorable socio-economic conditions and a local technician who had made a special effort to educate and empower women to utilize and care for solar power systems.

INTRODUCTION

Portfolio Review of USAID Decentralized Energy Activities

This document presents and compares three Tanzanian 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: Tanzania, India, and Brazil. Therefore, primary data were collected for applicable DE investments in these 3 countries, which together represent 13 case studies.[5] In a separate Synthesis Report, these case studies – the 3 Tanzania 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[6] 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 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.

[5] Five in Brazil. Five in India. Three in Tanzania.
[6] 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.

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-Decentralized Energy Portfolio in Tanzania

USAID's DE investments in Tanzania took the form of grants and loans to specific enterprises. Support recipients included in this report as case studies include:

1. Engineering Global Growth (EGG) – Energy;
2. Off-Grid Electric/M-Power; and
3. Zara Solar, via the FENERCA activity.

EGG – Energy was established in 2009 and received two USAID DIV grants, the first in 2012 and the second in 2013. The 2012 DIV grant is included in the wider portfolio review's formal inventory list of 31 investments. USAID support provided in the period following the 2012 portfolio cutoff is naturally still included in this report due to the instructive lessons it provides. The 2012 DIV grant was intended to support the development of systems for recruiting and training battery-charging entrepreneurs, as well as the installation of the first five EGG-Energy battery-charging franchises. During the first DIV funding period, the company began to transition to a new business model due to customer complaints that the charging stations were inconvenient. EGG then began selling solar systems to individuals and small businesses on a rent-to-own basis. The company applied for the second DIV grant to improve its data infrastructure, including linking mobile money systems with the company's customer service records; developing data applications to track logistics, inventory, and customer management; and training staff to use new software systems. This enterprise is examined as Case Study 2. It was selected because it represents a unique case that successfully pivoted its business model when confronted with customer dissatisfaction.

Off-Grid Electric is a solar company that sells low-cost lighting and cellphone-charging services to customers in East Africa. Its Tanzania operations are run under the name M-Power, and the company markets its services to the rural poor, with prices similar to the average Tanzanian's expenditures on kerosene. M-Power was incorporated in 2011. Unlike EGG, M-Power offers a service, and the company retains ownership of the system without a rent-to-own option. Customers access the service by paying an installation fee ($6), plus a fee for service (equating roughly $1.25 per week). The company's base offering is a 5Wp panel that allows for mobile phone charging and two to three lights. Once the system is installed, customers pre-pay for several days of service via mobile phone to receive an unlock code that activates the installation. USAID provided the enterprise with a DIV grant in 2013 and a second in 2014. Despite the grant period of performance starting after the review's window of interest (investments beginning between 2004 and 2012), it is included because the firm was founded prior to the cutoff. Further, this case (Case Study 3) provides an interesting comparison with EGG, and is unique in the portfolio in the sense that customers do not have the option to purchase the solar installations M-Power provides.

The FENERCA activity (Increased Use of Renewable Energy Resources Program – Financiamiento de Empresas Energéticas en Centroamérica), was a USAID cooperative agreement held by E+Co initiated in 2000 and ended in 2005. FENERCA's objective was to promote the development of renewable energy enterprises and projects, while increasing the capacity of financial institutions, entrepreneurs, and NGOs. FENERCA operated mainly in Latin America but was later expanded to Sub-Saharan Africa, including Tanzania. The FENERCA activity itself is classified as an STA investment approach, but its specific support to Tanzanian firm Zara Solar is classified in this report as an ES investment. E+Co provided Zara Solar with three loans (in 2001, 2004, and 2005) to gradually build Zara and its mother company's inventory and expertise in the clean energy market. Zara Solar is examined as Case Study 1. It was selected because it was a relatively early mover in the DE-sector in Tanzania and provides a temporal comparison with the EGG and M-Power, which entered the market later. Because USAID's partnership with E+Co. began prior to 2004, it is not considered part of the wider review's 31-activity inventory.

Geographic Coverage

FIGURE 1 illustrates the approximate location of USAID's DE activities in Tanzania for the three activities described above. Locations represent headquarters, founding locations, or pilot sites, as applicable.

FIGURE 1: MAP OF USAID DE SITES IN TANZANIA

Activities Selected for Case Studies and Justifications

Expanding on the previous section, Table 1 outlines important characteristics concerning each case that is examined in-depth in this report.

TABLE 1: CASE STUDY DETAILS AND SELECTION CONSIDERATIONS

DE Enterprise	Period	Technology	No. of Beneficiaries	Sites Visited	Selection Considerations
Zara Solar	Received FENERCA loans in 2001, 2004, and 2005	Photovoltaic (PV) SHS and related products ranging from small solar lanterns to large systems greater than 400 watt-peak (Wp), with lights, wiring, batteries and charge inverters.	End of USAID funding: >3,000 systems During fieldwork: >60,000 systems	Middle to upper-income households near Sengerema Town, Sengerema District, Mwanza Region	MMEE (Zara's parent company) received a series of loans from E+Co to help build expertise in clean energy and enabled the company to purchase large quantities of solar components. As a condition of the third and final loan, MMEE opened Zara Solar, which focuses exclusively on solar. This activity was selected because it represents one of the older activities in Tanzania, allowing sustainability and scale to be assessed.
EGG-Energy	Received USAID grants in 2012 and 2013	50Wp to 200Wp solar systems, including lights, appliances and commercial-scale cellphone and battery charging	2014: 191 PAYG system installations and 487 solar installations March 2015: An additional 113 solar systems (estimated)	Iringa Region, and Tanga Region	This activity was selected because the company has transitioned away from its initial model, suggesting useful lessons learned through failure and the opportunity to compare the company's original and current business models.
M-Power	Received USAID grants in 2013 and 2014	5Wp SHS with two to three lights and cellphone charger; 10 Wp system with four to five lights, cellphone charger and radio	2014: >10,000 systems Arusha Region); 554 systems (Kilimanjaro Region) 2015: >60,000 systems	Arumeru and Kilinga villages (an hour's drive from Arusha)	M-Power received DIV funding to pilot its operations in Arusha, Tanzania. This activity was selected because the company's large customer base and rapid growth provided an opportunity to interview a range of beneficiaries, as well as the opportunity to examine the factors responsible for rapid expansion.

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 31-activity inventory of 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 Tanzania.[7]

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 Tanzania-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 which constitute the review's full-inventory. In consultation with USAID, the review team was encouraged to expand the potential list of in-depth case reviews to those activities that bordered the 2004 to 2012 timeframe requirement. This flexibility was helpful because time-frame cutoff concerns were secondary to collecting relevant ex post findings from a rich set of varied cases.

Priority cases for Tanzania were selected in conjunction with those in Brazil and India, for the purpose of later cross-country, cross-case comparisons for the forthcoming Synthesis Report. Thus betwen the three countries, it was important to select a varied set of cases that would allow the review team to compare contextual, technical, and implementation-related factors to answer the review's three research questions.

Cases were prioritized to include likely successes (such as Zara Solar and M-Power) and failures (such as EGG, which adapted its approach to later become more successful). Finally, practical considerations such as (1) responsiveness of informants, (2) logistics, (3) schedule, and (4) budget were weighed to arrive at the three cases presented in this report.

[7] The review team delivered a country selection paper in April 2015, justifying primary data collection in three regions: Southeast Asia, Sub-Saharan Africa, and India. Because a significant body of research was already available for USAID investments in the Philippines and Indonesia, Brazil was suggested by USAID for in-depth study due to its relatively older portfolio of investments than was the case in Tanzania and India. India was the most active host-country in the portfolio (six investments), making it a natural choice for in-depth review. Tanzania was also well represented, albeit several investments began just outside the review's period of interest. These Tanzanian cases represented an interesting comparison with cases from the other two countries. Further, DE market opportunities and challenges in Tanzania represent similar opportunities and challenges found in other lower-income/low energy access countries where USAID provides DE support.

Data Collection

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

TABLE 2: NUMBER OF INTERVIEWS CONDUCTED FOR EACH CASE

Type of Interview	Zara Solar	EGG Energy	M-Power	Total
IDI (Local Context Providers)	1	2	2	5
IDI (Implementer)	2	6	2	10
Beneficiary IDI	9	12	15	36
Site Visits	7	6	15	28

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. Since the review team visited more than one site per case, 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. Informant identification was a particular challenge for Case Study 1 – Zara Solar due to the age of the investment. It was not possible for the review team to interview E+Co. staff, nor confirm that all three loans lent to Zara were supported by USAID's FENERCA Program. Additionally, the technical assistance portion of the FENERCA support was not assessed because of staff turnover. Another limitation was in site selection for all three cases. The firms themselves guided the review team to client installations therefore site reviews discussed in this report may not be representative of the larger set of products installed by any one organization. For instance, the review team visited 15 of some 60,000 installations that M-Power has installed. Site visit descriptions are provided in this report to give a sense of the how beneficiaries utilize the applicable system.

COUNTRY OVERVIEW

Approximately 20 percent of Tanzanians, primarily in urban areas, have regular access to electricity; and as of 2013, only three percent of rural Tanzanians have connections to the grid (Lighting Africa, 2013). A single vertically integrated state-owned utility, TANESCO, provides electricity services in Tanzania, although independent power producers are allowed and encouraged to produce and sell electricity to TANESCO at preferential rates. As of 2015, the current tariff for general usage was $0.16 per kilowatt hour (kWh), which is less than the full cost of service incurred by TANESCO (African Development Bank, 2015). A heavily subsidized tariff of 60 Tanzanian shillings (Tshs), or about 3 cents, per kWh exists for customers who use less than 75 kWh per month (TANESCO, 2015).

What grid access does exist is seen as unreliable. This problem has become worse in recent years as recurrent drought has diminished hydroelectric generation and Tanzania's ongoing efforts at grid extension have resulted in more grid connectivity but poorer quality. (Msyani, 2013). Power outages are increasingly common. Numerous interviewees for this review mentioned frequent blackouts as a problem with the national grid. The country is actively investing in new infrastructure and power plants to improve grid reliability and has developed a regulatory framework to encourage private sector investment in a wide range of power-generation technologies.

One of Tanzania's policy priorities is to increase access to electricity in rural areas. The Rural Energy Agency (REA), created in 2005, has actively supported rural electrification. International donors provide

most of REA's funding and work through it to extend technical assistance to remote areas. The REA prioritizes grid extension and is in the process of extending medium-voltage lines to hospitals, schools and other institutions throughout the country (REA official, interview during fieldwork in Dar es Salaam, July 2015). In every location that the review team visited, the grid had recently come to the area, subsidized by REA. Since 2012, REA also subsidizes costs for low-usage customers to connect to the grid, reducing the cost for rural customers to $110, although beneficiaries report long wait times for connections (African Development Bank, 2015). REA officials expect to begin focusing on household connections during the next phase of grid extension, after completing the installation of medium-voltage lines (REA official, personal communication, 2015).

The legal framework for off-grid renewable energy systems is under development by REA, and its long-term future in Tanzania is less clear. Numerous government officials expressed the view that stand-alone solar home systems are a temporary solution until the grid reaches the entire country, and then will serve mainly as backup for the grid. Nonetheless, the Government of Tanzania has implemented several activities in support of off-grid renewables. From on or about 2004 to 2009, the Tanzanian Ministry of Energy and Minerals (MEM) worked with the United Nations Development Program (UNDP) to implement a project designed to transform the market for solar power ("the UNDP-MEM project") in the Mwanza District, a remote area in the northern part of the country. That project resulted in some favorable policy changes, such as reduced import tariffs on solar components, as well as consumer education, demonstration activities and programs to train technicians in solar installation and maintenance (Hamid and Magessa, 2009). Following the success of the UNDP-MEM project, the Swedish International Development Cooperation Agency (SIDA) has worked with MEM to implement a similar solar market transformation initiative in other regions of Tanzania.[8] The World Bank also funds a Tanzania Energy Development and Access Project (TEDAP), implemented by REA, which includes support for off-grid energy systems and services (MEM/REA, 2014). Notably, one of REA's missions is to ensure that rural electrification strategies consider the needs of women, both as potential employees and as beneficiaries of energy services; the agency has incorporated gender considerations into its hiring and funding practices, including gender-themed training programs for DE businesses that receive financial support from REA.

CASE STUDY SUMMARY 1: ZARA SOLAR (ES)

Activity Overview

Zara Solar is the sister company of the older firm Mona-Mwanza Electrical and Electronics (MMEE). MMEE/Zara received financing support through the FENERCA program in 2001, 2004, and 2005. FENERCA is a USAID cooperative agreement held by E+Co initiated in 2000. FENERCA's objective was to promote the development of renewable energy enterprises and projects, while increasing the capacity of financial institutions, entrepreneurs, and NGOs. FENERCA operated mainly in Latin America and Sub-Saharan Africa.

MMEE sold electronics equipment in the Mwanza region of Tanzania upon its launch in 1998. Starting in 2000, the company's owner became increasingly interested in selling solar home systems and began working with solar experts in East Africa, including E+Co.[9] MMEE/Zara received three loans from E+Co

8 The SIDA-funded project was less comprehensive than the UNDP-MEM project, and solar demand in Mwanza continues to outpace demand elsewhere in Tanzania (Zara Solar official, personal communication from interview during fieldwork in Mwanza, July 2015).

9 E+Co ceased operations as nonprofit impact investment organization in 2012 and transferred what remains of an approximately $30 million loan portfolio to private-equity fund managers. E+Co was restructured as a new entity, Persistent Energy Partners (PEP), a for-profit holding company that manages E+Co's remaining assets in Africa. PEP also oversees the two private fund managers that manage E+Co's remaining assets in Latin America and Asia.

that helped build its expertise in off-grid energy. In 2001, E+Co provided its first loan of $50,000, which allowed MMEE to expand its retail business to include solar PV systems. E+Co provided technical assistance to help MMEE complete a business plan and in 2004 disbursed a second loan for $100,000. The second loan enabled MMEE to purchase solar PV components in bulk.[10] As a condition of a third loan from E+Co in 2005, MMEE split its operations into two companies, opening Zara Solar, Ltd., a sister company with the same owner, location, customer base and business model, but that exclusively provided customers with high-quality and relatively affordable solar PV systems. This report notes that there is some ambiguity about whether or not each of these three loans were tied to USAID-FENERCA support. These loans were dispersed by E+Co; however, may have been part of its investment plans outside of USAID-DE support. Officials from E+Co were not available for interview.

At the time of the review team's visit, MMEE remains an electronics store, while Zara Solar has become a leading solar business in Northern Tanzania. Zara sells products ranging from small solar lanterns to large systems (over 400 Wp), along with batteries, power inverters, and other components.

Zara Solar partnered with the United Nations Development Program's (UNDP's) Transformation of Rural Photovoltaic Market in Tanzania, which the Tanzanian Ministry of Energy and Minerals (MEM) implemented from March 2004 to July 2009 as the UNDP-MEM project. The UNDP-MEM project aimed to reduce Tanzania's energy-related carbon dioxide (CO_2) emissions by introducing PV as a substitute for kerosene to light rural areas. Under one of its five main objectives – "strengthen private sector capacity to provide quality services and develop PV packages that suit rural applications" – the UNDP-MEM project increased knowledge of PV in the area through awareness campaigns and broad technical training programs. In particular, UNDP-MEM trained more than 200 technicians on PV systems and made technical training available through the Vocational Education and Training Authority (VETA) in Mwanza, Shinyanga, Kagera and Mara as part of the authority's teaching programs.[11]

Zara Solar's partnership with the UNDP-MEM project was a factor for sustainability in that the company does not offer installation or after-sales service directly. Instead, Zara taps into a network of self-employed technicians, trained primarily through the UNDP-MEM project. When customers purchase solar equipment from Zara Solar, the company refers them to one of these technicians. The technician then installs the equipment, trains the customer in its use and maintenance and conducts ongoing maintenance for a fee negotiated with the customer. The company's target demographic is households with a reliable source of income and institutional customers such as schools, hospitals, and clinics that lack access to electricity.

By 2007, Zara Solar and MMEE had sold more than 3,600 systems, benefiting at least 18,000 people. Zara Solar received an Ashden Award for excellence in the field of green energy.[12] At the time of the review team's visit, the company had installed more than 60,000 systems in northern Tanzania.

Timeline of Operations

Table 3 presents a timeline of events relevant to how MMEE and Zara Solar developed its operations.

10 E+Co Increased Use of Renewable Energy Resources Program (FENERCA) Final Report, USAID-Sponsored Leader with Associates Cooperative Award Number LAG-A-00-00-00008-00 October 2005. The MMEE/Zara Solar representative interviewed said he was not aware that this loan was associated with FENERCA or any USAID-funded activity.
11 "Transformation of Rural Photovoltaic Market in Tanzania Project (Project No. 00035062) Terminal Evaluation Report Final Report" by Mohamed Ali Hamid and Finias Magessa, August 2009.
12 "Zara Solar, Tanzania Affordable Solar Energy for the Rural Poor," retrieved from http://www.ashden.org/winners/zara.

TABLE 3: ZARA SOLAR TIMELINE OF OPERATIONS

Date	Activity
1998	MMEE, an electrical supply company, is established in Mwanza, Tanzania.
2001	Social finance organization E+Co lends MMEE $50,000 to build its solar PV expertise and offerings.
2004	As part of its cost-share contribution as the main implementer of the USAID-funded FENERCA program, E+Co provides a $100,000 loan to allow Zara Solar to purchase solar panels in bulk.
2004 – 2009	Zara Solar participates in the UNDP-MEM project Transformation of Rural Photovoltaic (PV) Market in Tanzania.
2005	Solar PV has grown to one-third of the company's business; MMEE requests another loan from E+Co.
2005	E+Co lends $200,000 on the condition that MMEE create a sister company (Zara Solar) devoted exclusively to selling solar PV.
2015	At the time of fieldwork, the company had installed more than 60,000 systems in northern Tanzania.

Purposes of USAID Funding

Specifics in activity documentation pertaining to the FENERCA program are limited, as available documents describe E+Co's global portfolio rather than detailing the support it provided to individual clients. E+Co is no longer in business thus it was difficult for the activity team to follow up with implementers of the program. While MMEE/Zara respondents were unsure of the link with USAID, loans provided through E+Co were used to gradually expand MMEE's, then Zara's, solar PV offerings; resulting in Zara's focus in providing solar-based lighting solutions throughout the northern Tanzania.

Site Descriptions

Zara's customer base is in Mwanza, the capital of the Mwanza Region and Tanzania's second-largest city. Within Zara's service territory, data was collected in the Sengerema District, which borders Lake Victoria in the north of the Mwanza Region. The district's population in 2012 was 63,000, and 75 percent of Sengerema's population relies on agriculture, with average farm size between 1 to 3 acres (UNDP, 2012). However, the Sengerema District is also dominated by a market town that supports merchants and provides housing for professionals such as teachers and government employees. While Zara Solar's customers include rural households and farmers, the sites visited by the review team in the Sengerema District included schools, a nursing college and several middle and upper-middle income households, all within a short distance from Sengerema Town.

Implementation-Specific Factors

This section describes the implementation-specific factors at the time the USAID-related activity period ended. In this case, that is the end of the FENERCA program in 2005.

- Technology: Zara Solar sells SHSs, which are small stand-alone electrical systems that consist of a PV module to generate electricity from sunlight, a rechargeable battery to store electricity for use both day and night, a charge controller to prevent the battery from being overcharged or deep-discharged and fluorescent lamps, wiring and fixtures.[13] The most popular technology was a 14 Wp panel with one battery and two lights, which can be used for about three hours a night.
- Target beneficiaries: Households and institutions in the Mwanza Region that lack access to the electricity grid but have sufficient income to purchase solar equipment.
- Payment methods: Most customers paid in full at the time of purchase, but Zara was also piloting microfinance through local savings and credit cooperative organizations (SACCOs).

13 "Providing Affordable Solar Systems in Northern Tanzania," a report based on information provided to the Ashden Awards judges by Zara Solar and findings from a visit by one of the judges to see their work. (Dr. Anne Wheldon, Technical Director, Ashden Awards and Dr. Mike Pepler, Technical Manager, Ashden Awards, May 2007.)

- Maintenance: Freelance technicians, trained by the UNDP-MEM project, performed installation and maintenance at fees negotiated with the customer.
- Planning method: The solar component of the business has grown in response to market demand. Zara has coordinated its activities with the UNDP-MEM project, which was underway when USAID funding ended.
- Community engagement: Zara has worked closely with local, national and regional officials via membership in business and solar-specific societies and maintains an extensive network of trained technicians within its service territory, with support of the UNDP-MEM project. Its business plan requires these technicians to educate customers about the use and limitations of their systems.
- Other: The UNDP-MEM project created an enabling policy environment, increased customer awareness of solar power and trained hundreds of solar technicians in the area, all of which helped boost Zara's solar business.
- Initial challenges:
    1. Lack of low-cost finance limited Zara's customer base
    2. End-users' lack of understanding about the limitations of their systems

Implementation Changes Over Time

- The company's basic technology and business model has not changed, although it has grown substantially.
- After experimenting with microfinance options, the company concluded that finance fees are too high; they have abandoned attempts to procure microfinance and now sell only to customers who can afford the upfront costs (e.g., professionals, institutions, entrepreneurs and farmers who receive seasonal lump-sum income).

Status at End of USAID Investment

In 2005, when the company received its second loan from E+Co, it had installed 3,600 systems. The company does not formally track social outcomes, but a 2007 technical report prepared in conjunction with the Ashden Awards notes that Zara solar systems improve quality of service in health centers and schools, and some Zara customers earn extra income by allowing patrons to charge mobile phones or using solar lighting or TVs to attract customers to bars and cafes (Ashden Awards, 2007).

Status at the Time of Data Collection

The company has experienced substantial growth since receiving the three loans from E+Co. The number of beneficiaries has grown from around 3,000 to more than 60,000, and system capacity has increased as the price of solar PV dropped (Zara Solar official, August 2015). The company did not provide information on the number of systems that are still operational, but the owner and both technicians interviewed reported that "all or nearly all" systems were working well. These assertions are supported by field interviews, where all of the observed systems were working, some of them for longer than 10 years. However, the service territories examined were close to Mwanza and staffed by well-trained technicians who may not have been representative of all areas served by Zara. The company has an office in Dar es Salaam, but its primary operations remain in Mwanza.

Conclusions

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

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

To answer this question, the review team: examined company documents; conducted a site observation in July 2015 at the store in Mwanza; interviewed the company's CEO and two freelance technicians associated with Zara; and conducted 10 interviews and site observations with beneficiaries in two locations: in and around Mwanza town and in Sengerema District. In these interviews, the review team collected data on several dimensions of sustainability, including the current production capacity and overall condition of the installed systems, the ability of maintenance systems to keep the solar home systems in good repair, the number of end beneficiaries and systems' capacity to meet beneficiaries' energy needs.

Table 4 summarizes the findings for Question 1.

The systems observed were in good condition and interviewed beneficiaries expressed a clear understanding of their systems' functionality and limitations. Respondents could identify indicator lights on system batteries and explain how to monitor and adjust appliance use to meet system limitations.

Customers expressed a high degree of satisfaction with the service. However, many beneficiaries would have preferred a higher level of service, mentioning more lighting for additional areas of the home and the ability to power a television or iron. One technician also mentioned that other areas of Zara's service territory offered fewer qualified technicians, suggesting that user education and system maintenance may be lower there.

TABLE 4: ZARA SOLAR SUSTAINABILITY MATRIX

Dimension of Sustainability	Findings	Score 1 = below expectations; 2 = sustained; 3 = exceeded expectations
System Production Capacity	Since 2007, reduced solar PV costs enabled the sale of increasingly large systems, allowing users to power not only lights but radios, televisions and other appliances.	3
Current System Condition	Systems were working well and had been well maintained; some users reported continuous use for five to 10 years without needing to replace components.	3
Maintenance Capacity	UNDP-trained technicians were effective at installing and maintaining systems, although one beneficiary reported long waits for service.	2
Number of End Beneficiaries	The company has continued to increase the number of beneficiaries from around 3,000 to more than 60,000 systems, although business has begun to slow as the grid expands.	3
Capacity to Meet Beneficiary Needs	Users were happy with their systems, but many reported wanting additional services. Some beneficiaries reported interest in additional appliances. Three out of five women beneficiaries interviewed wanted power for refrigerators and irons, which would require larger, more expensive systems that are out of reach for even middle-class Tanzanians.	2

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

Like other solar companies, Zara has operated in a rapidly changing environment. Exogenous factors that affect sustainability include government policies and initiatives such as the UNDP market transformation project; global prices for solar components; and socio-economic conditions within the region. Because Zara does not offer financing to customers, the business is particularly reliant on a customer base with sufficient income to afford the upfront costs of its products. The field research findings suggest that Zara's fee collection and maintenance systems were contributing factors to the firm's sustained presence. Fieldwork revealed an additional factor that affected Zara's sustainability: its collaboration with the UNDP-MEM project, which undertook marketing activities and trained area technicians. Without the UNDP-MEM project, Zara likely would have had to make arrangements for in-house technicians and engage in additional marketing activities. Table 5 summarizes factors that contributed to the relative success of this case.

TABLE 5: ZARA SOLAR SUSTAINABILITY FACTORS TABLE

Independent Variable	Impacts on Whether Outcome Was Sustained	Implications for Future Sustainability
Exogenous Variables		
National policies	Government-supported initiatives in Mwanza helped to support Zara indirectly	New policies to expand the national grid could reduce Zara's customer base; technicians report reduced business in grid-connected areas.
Macroeconomic conditions	Worldwide demand for solar components reduced supply and increased Zara's costs during 2000-2010.	Declining solar power costs likely will decrease Zara's product costs, but rising inflation and shilling depreciation may offset them.
Socio-economic conditions	Customer base comes from institutions, professionals and well-off farmers; Mwanza has a good supply of trained solar technicians.	Socio-economic conditions in northern Tanzania may affect the company's long-term sustainability.
Activity-Specific Variables		
Community engagement	Zara's business plan involves extensive customer education and a partnership with UNDP-MEM supported community training efforts.	Strategic relationships with actors such as UNDP-MEM have reduced Zara's operating costs.
Fee collection systems	Cash-only systems reduce company risk of non-payment, but are restrictive to low-income customers.	While there are benefits to cash-only systems, it will likely impinge on the ability to scale rapidly to customers without access to financing.
Maintenance systems	Freelance technicians perform installation and maintenance.	Without ongoing UNDP-MEM support, the availability of trained technicians could decrease.
Other: Strategic relationships with other long-term actors in Tanzania's energy sector	Zara worked closely with the UNDP-MEM project, which undertook technician training and marketing activities.	Unclear; the program's benefits are still evident six years after its end.

Summary of Question 1 Conclusions

Zara's sustainability is due at least in part to its strategic partnerships with UNDP-MEM, whose efforts helped bolster demand in the Mwanza Region and provide Zara with a network of trained technicians. Zara's systems provide sufficient power to meet household needs for lighting and television, and can

support some needs of growing businesses, but women in particular expressed interest in systems to power irons and refrigerators — services that are expensive to provide via solar power. Zara's upfront pricing system reduces cost and risk for the company, but also limits its customer base to those who can afford the systems. In the long term, grid expansion may reduce Zara's customer base.

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

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

The review team did not find evidence of a secondary activity. The company has grown substantially, but has not scaled outside of its main-service territory or the scope of its services. The context providers, implementers and beneficiaries interviewed were not aware of any replications of the company's approach by other adopters.

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

Zara Solar intends to continue to expand to meet demand in Mwanza, but does not plan to expand into other districts within Tanzania. The context providers, implementers and beneficiaries interviewed were not aware of any replications of the company's approach by other adopters. It is possible that other businesses in Tanzania will replicate Zara's model; while the review team did not identify any evidence of such other adopters, this review's search was not exhaustive for firms outside of USAID's support mechanisms. Table 6 describes observations relating to Zara's growth.

TABLE 6: ZARA SOLAR SCALING-UP CHECKLIST

Type of Scaling Up	Description of Observed Approach(es)	Implications for Sustained or Continued Replication
Replication	N/A	N/A
Expansion	Company's sales have increased, but the company has not expanded beyond Mwanza or added new services.	N/A
Collaboration	The company has collaborated with UNDP, which has helped to increase its business.	The UNDP project has not been replicated outside of Mwanza, suggesting that expansion of Zara's model beyond Mwanza may not be feasible without a network of trained technicians in place.

Component 2b: Under what conditions did the replication or scaling up occur?

Zara Solar has not been replicated, and while the company intends to continue to expand to meet demand in Mwanza, it does not have plans to expand into other districts within Tanzania. It is possible that other businesses in Tanzania will replicate Zara's model; while the review team did not identify any evidence of such adopters, its focus on USAID-funded companies and programs might not have elicited information about solar companies in other areas that did not receive USAID funding. To replicate Zara's approach companies in other districts would need a network of trained technicians, similar to the one in Mwanza that the UNDP-MEM project facilitated.

Summary of Question 2 Findings

In terms of scaling up, MMEE has not expanded its services or service area since it established Zara Solar. Albeit Zara has been able to increase its customer base from 3,000 to 60,000 over the course of the last

decade. As for replication, it is possible that other solar companies might replicate Zara's business model, but the review team did not find evidence of this. For Zara Solar to be scaled up or replicated, external support to create a network of trained technicians would likely be required, on a level similar to the establishment and training of a network of technicians provided via the UNDP/MEM project.

CASE STUDY SUMMARY 2: EGG ENERGY (ES)

Activity Overview

EGG Energy is a company that distributes and finances rent-to-own solar systems ranging from 50Wp to 200Wp. Small businesses or household-based customers purchase solar systems and appliances including lights, radio, television, and commercial-scale mobile phone charging stations. To finance the solar systems, customers must be deemed credit-worthy via community leaders or a local agricultural membership organization. Once approved, customers can purchase the systems by paying 10 percent down and the remainder in monthly installments over two years. The company's business model has evolved from an initial focus on entrepreneur-owned battery-charging hubs to its present focus on solar systems designed for home and small-business use. Along with this change in business model, the company has closed operations at its original site and has opened offices in other parts of the country, focusing on using strategic partnerships with agricultural membership organizations — primarily agricultural producer cooperatives — to market products and assess customer creditworthiness.

Timeline of Operations

Table 7 presents a timeline of events relevant to how EGG-Energy developed its operations.

TABLE 7: EGG-ENERGY TIMELINE OF OPERATIONS

Date	Activity
2009	EGG starts operations with a pilot battery-subscription service outside Dar es Salaam.
2011 – 2012	The company develops a business model based on solar-powered franchises, in which entrepreneurs would purchase 200Wp solar systems on a rent-to-own basis and operate battery-charging stations in remote areas.
Feb. 2012 – Jan. 2013	Funding period for EGG's first $100,000 DIV grant.
2012	EGG installs its first solar battery hub in Tungalamenga village in the Iringa District.
2013	The company begins to phase out the battery-charging service and starts marketing solar home systems.
	EGG signs a contract to sell Mobisol systems, allowing it to remotely monitor system performance and disable systems in case of non-payment.
	Funding period for EGG's second $100,000 DIV grant.
2014	EGG opens its office in Tanga, using partnerships with agricultural processing facilities to aid distribution.
2015	Company has installed over 600 systems in four regions of Tanzania.
	Company closes its Iringa office.

Purposes of USAID Funding

USAID support to EGG included two DIV grants (the first in 2012 and the second in 2013) for $100,000 each. When EGG-Energy first received USAID funding in 2012, its business model focused on solar-powered battery-charging hubs, which it planned to disseminate by recruiting entrepreneurs to purchase the systems and then run solar-powered franchises; the franchises made profit by providing battery-

charging services to the surrounding communities. The first DIV grant was intended to support the development of systems for recruiting and training battery-charging entrepreneurs, as well as the installation of the first five EGG-Energy battery-charging franchises. During the first DIV funding period, the company began to transition to a new business model that provided solar systems to individuals and small businesses on a rent-to-own basis. The company applied for USAID funding to improve its data infrastructure, including linking mobile money systems with the company's customer service records; developing data applications to track logistics, inventory, and customer management; and training staff to use new software systems. In an interview, the current EGG CEO indicated that USAID funding has helped increase investor confidence in the firm and helped the company attract additional financing from donors and private lenders.

Site Descriptions

The Iringa Region is in south-central Tanzania and produces much of the country's tomatoes, potatoes and onions. Within Iringa, members of the review team conducted site observations and field interviews in Tungalamenga, a village 100 km outside Iringa Town and the site of one of the company's original solar hubs. Because Tungalemenga is on the outskirts of Ruaha National Park, villagers have income opportunities from both farming and tourism. However, the roads connecting Tungalamenga with Iringa Town are unimproved and impassable during rainy periods, making the village particularly remote. Until recently, the village had no access to the electricity grid, but when the Rural Energy Agency extended the grid to the area, households began gradually receiving service.

The Tanga Region lies along Tanzania's coast north of Dar es Salaam. Like most regions of Tanzania, agriculture dominates the economy. However, Tanga is the fourth-largest city in Tanzania and is a major port for exports such as coffee, tea and sisal. The review team visited Tanga Fresh, a milk cooperative in Tanga that is one of EGG's strategic partnerships.

Implementation Specific Factors

- Technology: Originally, EGG-Energy offers 50Wp to 200Wp solar systems, including lights, appliances and commercial-scale mobile phone-charging and battery-charging systems.
- Target beneficiaries: Initially, primary beneficiaries were entrepreneurs with sufficient funds and capabilities to invest in and run a solar battery-charging hub, and secondary beneficiaries were battery-charging customers, who could use the batteries to power lights and other appliances. As the company's business model changed, households and businesses who could afford the rent-to-own systems became the beneficiaries.
- Payment methods: Entrepreneurs paid 25 percent upfront and then made weekly payments for two to three years. Payments were made via M-Pesa, a mobile money system that allows individuals to pay bills and transfer money via cellphone.
- Maintenance: EGG trained local technicians, who installed and maintained systems for two years.
- Planning method: The company conducted baseline surveys that identified the Iringa District as the initial area to identify entrepreneurs to run the battery-charging hubs. The company also hired a private consultant to market to communities in Iringa and recruit potential agent-entrepreneurs to establish hubs in remote villages in the district.
- Local community involvement: The company recruited local community members as entrepreneurs, sales agents and repair technicians, and conducted extensive outreach and marketing in the Iringa area.
- Other: As EGG-Energy changed its business model, it developed software systems to collect detailed data on installations, system performance, agent performance and other metrics.
- Initial challenges: Battery-charging was inconvenient for customers and offered few cost advantages as the price of SHS decreased. Franchisees preferred smaller 50 Wp systems rather

than the initial 200 Wp offering. EGG-Energy also found that its bill collection procedures were not streamlined.

Implementation Changes Over Time

Technology: EGG currently offers customers a choice of systems ranging from 50Wp to 200Wp and is adding smaller 10Wp systems. They also sell appliances, including phone-charging systems, lights, TVs and DVD players. They are not committed to a particular technology and will add new products/brands to meet customer demand.

Target beneficiaries: EGG markets its products to households or businesses that lack access to electricity but have sufficient income to purchase one of EGG's products. The company's marketing efforts target groups of end-users with similar needs and income levels and who can be identified via existing associations such as agricultural membership organizations (e.g., milk producers who belong to a milk cooperative).

Payment methods: Customers pay 10 percent down and make monthly payments for two years via M-Pesa. All of EGG's products are equipped with Global System for Mobile Communications (GSM) chips, which allow EGG to turn off service remotely in case of non-payment. Systems can be repossessed for non-payment, but the company has flexible payment arrangements to allow customers with seasonal incomes to catch up before EGG proceeds with repossession.

Maintenance: EGG has not changed its approach to maintenance.

Planning method: The company leverages relationships and partnerships with agricultural membership organizations to support expansion to new locations, in which the membership organizations provide relevant customer information and facilitate marketing for a small fee.

Community involvement: EGG changed its strategy for outreach to target communities through agricultural membership organizations. Mobile sales teams go to new locations for several weeks to identify potential customers; as EGG gains a customer base in a new location, opportunities exist for local community members to become trained as sales personnel or technicians.

Current challenges: Limited access to capital constrains the firm's ability to scale quickly and meet growing demand. The EGG business model requires a critical mass of customers to make operations feasible and profitable in a given area. Some customers reported poor after-sales service, although it is not clear if these issues will be limited to the original location in Iringa (where EGG is no longer operating) or if they will recur in the new locations.

Status at End of USAID Investment

By the end of the USAID-DIV grants, the company had installed six solar hubs and had begun to sell smaller SHS, in addition to systems used by local agricultural membership organizations. The company also tracks outcomes such as income generated by entrepreneurs, reduced kerosene use and cost savings to households using EGG services. The final USAID report estimates that the first hub in Tungalamega brought the owner $250 in net profit each month, mostly from cellphone charging, and that the average battery-charging customer saved $1.97 per month.

Status at the Time of Data Collection

A business plan written in March 2015 indicated that the company had installed more than 600 solar home systems across four regions, with the smallest and most popular systems sized at 50Wp. The company monitors system performance remotely and reports that all or nearly all of the systems work well. The two sites the review team visited supported this. Some, but not all, of these systems support entrepreneurial activities such as cellphone charging. However, interviews with the original solar

entrepreneurs in Tungalamenga indicated that their income had decreased fourfold from its early peak due to competition. This was significant enough to compromise the entrepreneurs' ability to pay for the systems, although the systems also provided light that helped extend business hours in the family shop. Dairy farmers in the Tanga Region similarly indicated that the systems helped improve farm productivity by allowing them to undertake chores in the evening or early morning. A 2014 survey reported in the company's business plan indicated that 84 percent of customers no longer used kerosene, saving an average of 130 liters and the equivalent of $150 annually.

Conclusions

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

Component 1a: Sustainability

The review team examined EGG's milestone reports and a business plan from March 2015, as well as interviewed the current CEO, one former technician, one former agent, and five beneficiaries in the original Tungalamenga location; and the current office manager, two technicians and three beneficiaries in the new Tanga office.

Due to discrepancies between the indicators reported to USAID in EGG's milestone reports and the indicators that EGG provided to researchers, the review team was unable to calculate the change in installations since USAID funding ended. In the final assessment report to USAID in October 2014, the company reported 191 PAYG system installations and 487 cumulative solar installations; it is not clear from the report whether these two categories of installations are mutually exclusive. An EGG business plan dated March 2015 reported that EGG had installed 600 solar systems as of March 2015, but did not include PAYG systems as a separate category. Assuming that the 487 installations included the 191 PAYG systems, this suggests that EGG installed 113 solar systems between the time USAID funding ended and March 2015. The company has also opened offices in Tanga and Pwani.

The review team's interviews and site visits suggest that these systems remain in good working condition, although after around two years of use, system batteries often begin to fail. Three customers reported that battery problems had reduced the amount of light their systems would generate. Beneficiaries also reported that the company no longer provided free maintenance on the systems, consistent with interviews noting that the company had closed its Iringa office. However, all interviewed beneficiaries continued to value the systems, and two of the three beneficiaries who reported battery problems had undertaken battery replacement on their own, suggesting that some EGG customers may be able to sustain their systems even if the company no longer operates in their area.

Customers were happy with the service, but nearly all wanted additional appliances or larger systems. Several customers had systems that were large enough to power a television, but did not have a TV because of the additional cost. Female respondents in particular wanted systems that could meet needs such as refrigeration, cooking, and ironing.

TABLE 8: EGG-ENERGY SUSTAINABILITY MATRIX

Dimension of Sustainability	Findings	Score 1 = below expectations; 2 = sustained; 3 = exceeded expectations
System Production Capacity	**Below Expectations:** Nearly half of Iringa beneficiaries interviewed mentioned battery problems that reduced the systems' capacity.	1
Current System Condition	**Sustained:** Activity documents, staff interviews, and beneficiary interviews confirm that most systems are working well.	2
Maintenance Capacity	**Sustained:** The company has ceased to maintain systems in its original location, but beneficiaries interviewed had undertaken maintenance on their own.	2
Number of End Beneficiaries	**Exceeded Expectations:** The number of beneficiaries has increased since USAID funding ended.	3
Capacity to Meet Beneficiary Needs	**Sustained:** Beneficiaries are happy with the systems, many of which can power radios and TV. However, nearly all beneficiaries, including both household and business customers, expressed interest in larger systems that would meet more needs. Women in particular expressed a need for additional lighting.	2

Component 1b: Conditions for Sustainability

EGG's experience is useful to examine the factors that support sustainability, because its initial business model and location were not sustainable and the company is piloting a new model in a different location. It is useful to distinguish between sustainability of the company and sustainability of the solar power systems. The company's original battery-charging operation was unsustainable on both counts, and the company switched to selling rent-to-own solar systems in the same region. The region proved unprofitable for the company, which moved and piloted a refined business model in Tanga. However, the systems remain operable and former EGG customers indicate a willingness and ability to undertake their own maintenance, suggesting that sustainability may not depend entirely on the company's continued presence in the area.

This willingness and ability to pay, however, may decline as customers and potential customers gain access to grid electricity. Indeed, the grid has recently arrived in Tungalamenga, but few households are connected because it requires a wait time and a fee; also, the grid is unreliable and subject to frequent outages. While EGG customers reported that they would keep their systems even if they had grid access, the company's CEO reports that non-payment rates are higher for customers with grid access.

The company's change in business models and locations responded to challenges encountered and lessons learned during the early years of operation. The most significant change is that the company now markets its products primarily through strategic, commission-based relationships with agricultural membership-based organizations, which provide EGG with access to a regular customer base and help the company assess customers' creditworthiness. Another significant change is that the company now uses systems that can be shut off due to non-payment; in interviews, the company's CEO said this has reduced EGG's risk of non-payment substantially. While the Tanga business model has not been in place long enough to fully assess its sustainability, both the CEO and the location's manager report that the new marketing approach and changes in product technology have supported rapid growth in the area.

One factor that EGG has not fully addressed is long-term maintenance of its systems. EGG provides customers with a two-year warranty and maintenance period, and beneficiaries reported that EGG

successfully maintained the systems. In the original Iringa location, however, beneficiaries who had completed or nearly completed their two-year payment agreement reported that the company had ceased to respond to maintenance calls. The CEO mentioned plans to offer longer-term maintenance plans to customers. Currently, however, beneficiary experience suggests that the company has little incentive and few mechanisms to maintain systems past the two-year period. As a result, long-term system operability may depend on the company's ability to devise a service agreement or on customers' ability and willingness to maintain their own systems long-term. The company's customers and former customers in Iringa were willing and able to do so, but reliance on customers may not work well in areas where trained solar technicians are unavailable.

The factors that affect sustainability are summarized in Table 9, which includes both exogenous and activity-specific factors that affect sustainability, and includes factors identified as crucial for DE sustainability.

TABLE 9: EGG-ENERGY SUSTAINABILITY FACTORS TABLE

Independent Variable	Impacts on Whether Outcome was Sustained	Implications for Future Sustainability
Exogenous Variables		
National Policies	Unclear; the Government of Tanzania does not subsidize or regulate the company.	REA's current grid expansion efforts could reduce customer base, particularly if reliability improves; CEO reports high degree of non-payment when customers gain grid access.
Macroeconomic Conditions	Limited access to traditional capital constrains ability to offer credit to customers. Drop in shilling value increases costs of importing solar components.	Improved macroeconomic conditions would help long-term sustainability.
Socio-Economic Conditions	Business has relied on customer base with high incomes and limited grid access; new marketing approach relies on the presence of agricultural membership organizations.	Continued growth may depend on offering products for lower-income customers; company is in the process of expanding its product line accordingly.
Activity-Specific Variables		
Community Engagement	Extensive community outreach in marketing and recruiting created high demand for EGG products; engagement included use of local sales agents to market products in Tungalamenga and local technicians to repair systems.	Company employees have replaced local sales agents and technicians, and marketing now occurs via agricultural organizations; these strategies may be a more efficient way to engage with target customers.
Fee-Collection Systems	Inability to switch off systems for non-payment increased company risk	Current GSM-enabled systems reduce company risk and enable faster growth.
Maintenance Systems	Customers' willingness and ability to maintain systems has contributed to sustainability.	Current two-year maintenance guarantee may not support long-term sustainability without additional systems in place.
Other: Increasing Affordability for End-Users	EGG's ability to finance systems expands the customer base, but systems are still affordable only for customers with stable incomes. The company provides support for income-generating activities such as cellphone charging.	Plans to offer smaller systems will increase affordability. Long-term sustainability of cellphone-charging services to improve affordability is limited as more households gain access to the grid or purchase SHS.
Other: Partnerships with Membership Organizations	The initial mass marketing approach was not profitable for the company.	Current approach to market products through agricultural membership organizations reduces company costs and risks.

Question 1 Summary

While EGG's initial solar installations remain operable, its original business model was unsustainable because it exposed the company to a high risk of customer non-payment and because the battery-charging systems proved inconvenient for customers. While it is too early to fully assess the sustainability of the company's new business model, several factors suggest that the new approach will be more sustainable than the original model, including: the use of customer financing to make products more affordable, the use of GSM technology to reduce the company's risk of customer non-payment, and strategic partnerships with agricultural organizations to aid community outreach and marketing.

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

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

Since USAID funding ended, the company has modified its business model and is piloting the new approach, using a monthly payment structure and focused marketing towards agriculture organizations, based in Tanga.

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

The approach in Tanga differs in several aspects. First, the original battery-charging systems have been abandoned. Although the company continues to offer systems from 50Wp to 200Wp, it has developed relationships with a wider range of solar system suppliers and is adding new products and suppliers as it identifies better products on the market. The basic payment structure is similar, but the company now uses GSM-enabled products that allow it to remotely switch systems off. The company continues to support productive uses of energy such as mobile phone charging systems, but also markets systems designed for home use. EGG's primary approach to marketing is via agricultural membership organizations, although it also deploys mobile sales teams to villages to generate interest and identify potential customers.

TABLE 10: EGG-ENERGY COMPARISON OF ORIGINAL AND SECONDARY ACTIVITY

Component	Comparison	
	Original Activity	Secondary Activity
Technology	200Wp battery-charging systems; 50Wp cellphone-charging systems	50Wp – 200Wp systems with appliances
Fee Structure/ Payment Method	25 percent down and weekly payments via MPesa	10 percent down and monthly payments via MPesa, with shutoff for nonpayment
Maintenance Plan	Two-year maintenance guarantee	Two-year maintenance guarantee
Intended Use	Support entrepreneurial activities	Provide electricity for home, business use
Community Engagement Strategy	Widespread community outreach and use of local agents and technicians	Community outreach via agricultural organizations
Use (or Lack) of an Anchor Institution	N/A	N/A

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

The company's Tanga operations are growing, and the office has established partnerships with two agricultural organizations that have helped increase sales. However, given that the original office in Iringa has closed and the company has left its original location, the secondary activity in Tanga is best characterized as a change in implementation and business model in response to lessons learned and changing conditions, rather than true replication or scaling.

TABLE 11: EGG-ENERGY REPLICATION AND SCALING-UP CHECKLIST

Type of Scaling Up	Description of Observed Approaches	Implications for Sustained or Continued Replication
Replication	N/A	N/A
Expansion	Offices opened in Tanga and Pwani.	Company hopes to expand its Tanga success throughout south-central Tanzania. Continued expansion may depend on the company's ability to attract investors.
Collaboration	New strategic partnerships developed with Tanga Fresh and Katani Sisal.	The company has identified similar agricultural membership organizations throughout the country that may allow it to expand into new regions of Tanzania.

Component 2b: Under what conditions did the replication or scaling up occur?

A significant factor underlying the relative success of the Tanga office is its strategic partnership with Tanga Fresh, a dairy collective that has allowed EGG to market its products directly to member farmers.

TABLE 12: EGG-ENERGY SCALING-UP FACTORS TABLE

Independent Variable	Impacts on Secondary Activity	Implications for Future Replication
Exogenous variables		
National Policies	Unclear	The government's continued support for grid extension and subsidized grid connections, if sustained, could reduce customer base or increase non-payment.
Macroeconomic Conditions	Limited access to capital has slowed replication.	Access to finance could limit company's ability to expand quickly.
Socio-Economic Conditions	Secondary activity relies on strategic partnerships with agricultural organizations.	Presence (or absence) of similar agricultural organizations could help (or hinder) future replication.
Activity-specific variables		
Community Engagement	Secondary activity uses strategic partners to reach out to communities.	Presence of similar partners would help or hinder future replication.
Anchor Institutions	N/A	N/A
Fee-Collection Systems	Secondary activity uses GSM-enabled technology to reduce risk of non-payment.	Continued use will help rapid expansion, but may limit reach to areas where GSM is supported.
Maintenance Systems	N/A	N/A
Other – Access to Capital	Company has attracted capital investment from social enterprises.	Continued replication will require new streams of investment capital.

Question 2 Findings and Conclusions Summary

EGG is in the process of scaling up and has plans to open offices throughout Tanzania, but has not yet done so, primarily due to limited access to capital. In addition, the company's recent decision to shut down the original Iringa office suggests that its ability to scale may depend in part on its ability to attract a critical mass of customers in each new service territory. Without a sufficiently large customer base in a given area, the company may struggle to provide customer service and maintenance.

CASE STUDY SUMMARY 3: M-POWER/OFF-GRID: ELECTRIC (ES)

Activity Overview

Off-Grid: Electric is a solar company that sells low-cost lighting and cellphone-charging services to customers in East Africa. Its Tanzania operations are run under the name M-Power, and the company markets its services to the rural poor, with prices similar to the average Tanzanian's expenditures on kerosene. Unlike solar companies that sell SHS to customers, M-Power offers a service, and the company retains ownership of the systems. Customers access the service by paying a small installation fee, plus a daily fee for the service. The company's base offering is a 5Wp panel that allows for cellphone charging and two to three lights, with installation fees around $6 and daily charges that equate to $1.25 per week. Once the system is installed, customers pre-pay for several days of service via mobile phone to receive an unlock code that activates the installation. The company is responsible for maintaining or replacing faulty systems. Customers can drop the service at any time, or can upgrade to a higher level of service. At the time of fieldwork, the company offered a slightly larger system with five lights, cellphone charging and a radio for a higher fee.

Timeline of Operations

TABLE 13: M-POWER TIMELINE OF OPERATIONS

Date	Activity
2011	M-Power is founded.
2012	M-Power locates in Arusha, begins to conduct market research and refines its business model.
February 2013	M-Power has opened its Arusha office, installed 510 systems in the area and trained about 10 agents.
	M-Power receives the first installment of its first $100,000 DIV grant.
January 2014	M-Power has installed more than 10,000 systems in the Arusha Region and has begun operating in the Kilimanjaro Region, opening an office and installing 554 systems.
March 2014	M-Power receives $7 million in financing from a consortium of impact investors.
April 2014	The company opens an office in the Mwanza Region.
	The company has installed 11,947 systems, of which 11,269 remain deployed.
October 2014	M-Power receives the first installment of its second $100,000 DIV grant.
August 2015	End of the second DIV grant funding period. M-Power now has 11 offices across Tanzania and has installed more than 60,000 systems.

Purposes of USAID funding

M-Power has received two USAID DIV grants. The first grant, for $100,000, spanned February 2013 to April 2014 and assisted with operating costs and increasing the size of the company from roughly 500 installations to 1,500 installations. The second grant, for $100,000, spanned October 2014 to August 2015 and assisted with scaling up in new locations and testing new approaches for agent training and compensation.

Site Descriptions

M-Power's headquarters is in Arusha, the third-largest city in Tanzania and one of the most prosperous, due to its proximity to tourist attractions such as Kilimanjaro and Ngorongoro Crater. Outside Arusha town, however, the rural population in the Arusha Region relies on subsistence agriculture.

The review team visited two villages in M-Power's service territory, both within an hour's drive from Arusha town: Arumeru and Kilinga. Arumeru village is a 30-minute drive from Arusha and sits along the slopes of Mt. Meru. The village is relatively prosperous due to high amounts of precipitation for rain-fed agriculture and its close proximity to markets in Arusha. Kilinga village is a one-hour drive from Arusha and is middle income for the area.

Implementation-Specific Factors

Near the end of the first USAID-DIV grant in 2014, the following characteristics were reported:

- Technology: 5Wp solar home systems with two to three lights and cellphone charger; 10Wp system with four to five lights, cellphone charger and radio.
- Target beneficiaries: Households that lack grid access and currently use kerosene lighting.
- Payment methods: Customers paid an initial installation fee and then pre-paid for services. Customers were charged by the day but could choose how many days to purchase at a time. Payments were made via M-Pesa.
- Maintenance: Non-functional systems were repaired or replaced by M-Power.
- Method of planning: Market research.
- Local community involvement: Used local community members as agents to promote the systems, check on existing customers and undertake simple maintenance.
- Other: Used software systems to collect detailed data on installations, system performance, agent performance and other key business metrics.
- Initial challenges:
    1. Limited transportation infrastructure made getting personnel and supplies to remote areas difficult.
    2. Recruiting, training and providing adequate incentives to agents was a challenge.

How These Factors Changed Over Time

- The company's basic technology and business model has not changed.
- As the company expands, it has consolidated certain business functions at the central office in Arusha (e.g., a call center; maintenance and repair functions).
- Local agents have been replaced with mobile sales teams dispatched by the regional or district office; their customer service and maintenance functions are now undertaken in-house in M-Power's Arusha offices.
- The company now runs its own academy, a four-week program that trains recent graduates in basic business education and M-Power's systems. The company hires a substantial number from each academy cohort and offers the academy to meet upcoming personnel needs.

Status at End of USAID Investment

By the end of the first USAID funding period, the company had installed 11,947 total systems, of which 11,269 remained deployed; an additional 678 systems had been repossessed and not yet reinstalled in other homes.

In its agreement with USAID, the company agreed to track other goals, including the number of agents trained and the commissions paid to agents, both male and female; the number of additional study hours for children; and the net savings to M-Power customers. In its final assessment to USAID, the company reported that it had 191 active agents, with average agent payoff of $461 over the course of 12 months. The company did not report the number of male and female agents. The company reported 31,000 additional study hours for children, based on customer survey responses about study time before and after access to M-Power systems. The company estimated net savings to M-Power customers at $195 annually, or a total of $2.2 million. However, this was based on estimates of kerosene consumption prepared by the United Nations Framework on Climate Change ($4.20 per week) that do not reflect M-Power's own customer surveys. The company's data suggest that most customers spent less than $2 per week on kerosene prior to using M-Power's services and some customers continue to use kerosene. Actual annual savings to customers over the USAID funding period are thus likely much lower than $2.2 million.

Status at the Time of Data Collection

At the time of the review team's visit, M-Power had offices in 11 districts across Tanzania and had installed more than 60,000 systems. The company did not provide information on the number of systems that remained deployed, but estimated that three to four percent of customers eventually dropped the service, after which the customer's system would be redeployed to a new household.

Conclusions

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

Component 1a: Sustainability

To answer this, the review team supplemented M-Power's reporting documents with beneficiary interviews in three villages within two districts of the Arusha Region, where M-Power's began its operations and retains its headquarters. The team conducted 17 interviews with current and former customers, as well as prospective customers, who knew about but had not signed up for M-Power's services. The team also conducted a short interview with the company's chief financial officer. In these interviews, the team collected data on several dimensions of sustainability, including the current production capacity and overall condition of the installed systems, the ability of maintenance systems to keep the solar home systems in repair, the number of end beneficiaries and systems' capacity to meet beneficiaries' energy needs. These observations are summarized in Table 14.

The company has been successful at increasing its customer base. In its final reports to USAID at the end of the first funding period, the company reported that it had installed 11,947 systems, of which 11,269 were still in use. Nearly all of the systems that the review team observed were in good working condition. While customers mentioned long wait times for repair or replacement, at the time of fieldwork only one system was non-functional while its owner waited for M-Power to replace it. However, customers expressed some dissatisfaction with system capacity; while the Level 1 systems that the review team observed included three lights, users reported that they could power only a single light all night long. When they used the systems to charge cellphones, availability of light at night was limited. They reported that these problems were worse during the rainy season.

Customers expressed a high degree of satisfaction with the quality and brightness of the light. However, many said their energy needs were not met. All of the beneficiaries the team interviewed had a three-light system and chose to install lights outside, in the bedroom and in the living room; none of the observed

households had placed lights in the kitchen. Beneficiaries also reported that the systems would not power TVs, which they wanted for personal and sometimes business use.

Reports on the product's affordability were mixed. M-Power was perceived as out of financial reach for some customers who continued to use kerosene. It was perceived as cheaper than other solar systems on a weekly/daily basis, but customers with more education perceived M-Power as more expensive in the long run than buying a system outright. Many customers expressed dissatisfaction with M-Power's approach to pricing relative to its service levels, particularly when the service was diminished due to lack of sunlight or for other reasons. Others disliked the prepaid approach to pricing, and several reported that their pre-payments were not refunded when the system failed to perform. Nonetheless, beneficiaries said they valued the service, and most interviewed beneficiaries had kept the systems for a year or longer. Only one beneficiary that the review team interviewed had stopped using the service, and reported that this was because the grid became available in his village.

TABLE 14: M-POWER SUSTAINABILITY MATRIX

Dimension of Sustainability	Findings	Score (1 = below expectations; 2 = sustained; 3 = exceeded expectations)
System Production Capacity	**Below Expectations:** 25 percent of beneficiaries reported reduced system capacity over time.	1
Current System Condition	**Sustained:** Activity documents, agent interviews and beneficiary interviews confirm that the company repairs or replaces broken systems. Across all beneficiary interviews, only one system was not working at the time of fieldwork.	2
Maintenance Capacity	**Sustained:** After two-plus years of use, beneficiaries report that the company repairs or replaces broken systems, although maintenance is not prompt and beneficiaries sometimes wait weeks or months for replacement systems.	1.5
Number of End Beneficiaries	**Exceeded Expectations:** During the initial funding period, the company increased the number of installed systems from 510 to 11,947.	3
Capacity to Meet Beneficiary Needs	**Below Expectations:** Activity documents and beneficiary interviews confirm that the systems meet most users' needs for lighting. However, the three-light systems generally do not meet women's lighting needs, and the systems do not support income-generating activities such as cellphone charging or TVs/radios in businesses.	1

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

When M-Power first began operations in Arusha, it operated under a challenging set of conditions, including low incomes of the target customer base, limited customer knowledge of solar systems and limited transportation infrastructure. The company developed a business model that relies on pricing that is low enough to be competitive with kerosene for many users and that uses advanced software systems to track company performance. The company has also continuously adapted to changing conditions and addressed challenges that emerged, modifying its approach to maintenance and agent training, for example. These factors have helped the company distribute large numbers of M-Power systems in a short period of time.

Some of the factors that have supported rapid deployment of M-Power systems also limit the systems' value to customers. For example, while the low-cost systems are more affordable than most solar home systems, users reported that the systems break down frequently and the Level 1 systems, while affordable, meet only users' most basic energy needs. Similarly, while the company's "fee-for-service" approach was low-cost, users perceived it as expensive in the long run compared to other solar providers, because they paid for services indefinitely but would never own the system. Finally, the pre-payment system that reduces risk of non-payment to M-Power tends to shift risk to the customer; in the event that the systems fail to perform, the customer is left paying for services not received.

As with other off-grid companies in Tanzania, M-Power could be vulnerable to a reduced customer base as the government expands the national grid; this in turn could impact the long-term operability of M-Power's systems, which are proprietary and require maintenance by M-Power's in-house technicians. Interviews with firm employees suggest that the company anticipates a large and stable customer base, given TANESCO's slow grid extension, Tanzania's rapid population growth and M-Power's entry-level price below the cost of grid connection. However, the relative costs of TANESCO service connections and monthly costs can vary substantially with new programs subsidized by REA. For regular customers, M-Power's costs are far lower than using power from TANESCO, albeit at a much lower level of service. For customers whose usage is less than 50 kWh per month, monthly TANESCO bills are around $1.50, far lower than M-Power's offering. The long-term impact of the grid may depend on whether the government can sustain recent levels of rapid grid expansion, connect customers quickly, and continue to subsidize low-income use.

Table 15 summarizes the factors that affect sustainability and includes both exogenous and activity-specific factors that influence sustainability.

TABLE 15: M-POWER SUSTAINABILITY FACTORS TABLE

Independent Variable	Impacts on Whether Outcome Was Sustained	Implications for Future Sustainability
Exogenous Variables		
National Policies	Unclear; the Government of Tanzania does not subsidize or regulate the company.	New policies increase the extent of the national grid and reduce grid connection costs to less than $20 for low-usage customers. If sustained, this policy could reduce M-Power's customer base or reduce it to a "short-term solution" niche product.
Macroeconomic Conditions	Limited access to traditional capital has required M-Power to seek other sources of funding. The drop in shilling value increases the costs of importing solar components.	Improved macroeconomic conditions would boost long-term sustainability.
Socio-Economic Conditions	Limited transportation infrastructure has prompted the company to develop supply chain systems that work with existing (often informal) transportation infrastructure. Customer base is primarily rural farmers using the systems for household power.	The company's ability to appeal to the rural poor increases its likelihood of future sustainability.

Independent Variable	Impacts on Whether Outcome Was Sustained	Implications for Future Sustainability
Activity-Specific Variables		
Community Engagement	Initially, the use of local agents aided rapid installation of systems.	Unclear. The company's approach to community engagement has shifted over time and in-house sales teams and a customer service department have replaced local agents.
Anchor Institutions	N/A	N/A
Fee-Collection Systems	Prepaid systems reduce risk to the company, but increase customer dissatisfaction.	Limited company risk has supported widespread expansion.
Maintenance Systems	M-Power replaces faulty systems for repair at the central warehouse.	Unclear. Centralized replacement is efficient, but leaves customers dependent on the company for repairs.
Other: Increasing Affordability for End-Users	M-Power's systems are cost-competitive with kerosene and low-risk relative to other solar providers, making it affordable to low-income Tanzanians.	The high degree of affordability supports the company's ability to reach large numbers of beneficiaries.
Other: Use of Advanced Software	Software systems allow M-Power to track many aspects of performance and improve efficiency.	N/A

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

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

Toward the end of the first USAID funding period, M-Power opened a second office in Mwanza. Since then, the company has opened nine additional offices throughout Tanzania, for a total of 11 offices.

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

The secondary activity is similar, with modest adjustments to the business model in response to lessons learned from the initial operations in Arusha.

TABLE 16: M-POWER ORIGINAL AND SECONDARY ACTIVITY COMPARISON TABLE

Component	Comparison	
	Original Activity (During USAID Funding)	Secondary Activity (After USAID Assistance Ended)
Technology	5Wp – 10Wp solar systems, plus lights and chargers.	5Wp – 10Wp solar systems, plus lights and chargers.
Fee Structure/Payment Method	Customers prepay via MPesa.	Customers prepay via MPesa.
Maintenance Plan	Local agents repair or replace systems.	Systems are swapped out for repair in Arusha.
Intended Use	Basic household lighting.	Basic household lighting.
Community Engagement Strategy	Outreach via local agents.	Outreach via sales teams.

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

As of August 2015, the company has scaled up by expanding from two offices to 11 throughout Tanzania and has developed consistent policies and procedures for planning, opening, and staffing new offices.

TABLE 17: M-POWER REPLICATION AND SCALING-UP CHECKLIST

Type of Scaling Up	Description of Observed Approaches	Implications for Sustained or Continued Replication
Replication	N/A	N/A
Expansion	Expansion from the original Arusha office to 11 total offices and service territories throughout Tanzania.	The company plans to continue to open new offices, building on its success to date; each office has significant potential for new installations.
Collaboration	N/A	N/A

Component 2b: Under what conditions did the replication or scaling up occur?

The company has developed systems and procedures for opening new offices. Each new region is semi-autonomous in some regards, but operates by company-wide guidelines in its approach to distribution, marketing and tracking, and reporting data. Certain functions, such as a customer service call center and repairs to M-Power systems, are handled through the Arusha office, while regional offices are responsible for marketing and distribution region-wide. Local Tanzanians staff the offices, with initial support from Tanzanian managers from other successful regions. The M-Power Academy, a four-week training program that operates in conjunction with local technical colleges, supports staffing needs. The academy accepts students from regions where the company plans to open new offices, so that a ready pool of local graduates is available and trained in M-Power's culture, processes, and software systems. These and other factors that support scaling up are summarized in Table 18.

TABLE 18: M-POWER SCALING-UP FACTORS TABLE

Independent Variable	Impacts on Secondary Activity	Implications for Future Replication
Exogenous Variables		
National Policies	Unclear.	If sustained, the government's continued support for grid extension and subsidized grid connections could reduce M-Power's customer base.
Macroeconomic Conditions	Limited access to capital requires M-Power to seek outside/foreign sources of investment.	Insufficient data.
Socio-Economic Conditions	Lower incomes in new service territories.	Uptake may be slower in lower-income areas.
Activity-Specific Variables		
Community Engagement	Staff with local knowledge found to be crucial for replication, leading to formation of the M-Power Academy and reducing the use of local agents as primary outreach.	Ongoing training via the M-Power Academy may be necessary to continue opening new offices.
Anchor Institutions	N/A	N/A
Fee-Collection Systems	Streamlined fee-collection systems support replication.	

Independent Variable	Impacts on Secondary Activity	Implications for Future Replication
Maintenance Systems	Streamlined maintenance systems support replication.	
Systematized Processes for Expansion	The company has developed processes that facilitate opening new offices and support success in new regions.	Many of the new offices have been in operation less than one year. Continued replication may need to respond to lessons learned over time.

Questions 1 and 2 Summary

M-Power has reached a consistently high number of beneficiaries and has kept client systems in good working condition; the company's flexibility, software networks, and low-cost offerings have helped it maintain and add customers in the Arusha area. M-Power has also successfully scaled up through expansion by opening a total of 11 offices throughout Tanzania. The review team was unable to gather systematic evidence about the performance of the new offices, but an interview with the company's CFO suggests that sales have been rapid in most of the new offices. The company's streamlined approach to distribution, payment and maintenance have enabled the opening of the new offices, as has the development of systematic procedures for opening new offices, hiring new staff and commencing operations in new regions of Tanzania.

CROSS-CASE-LEVEL FINDINGS AND CONCLUSIONS

This report has presented three case studies, each of which provide instructive lessons for sustaining DE investment outcomes and contributing to scalable solutions. Table 19 briefly summarizes the degree of sustainability and scale each case achieved. Below, this section discusses cross-case findings and conclusions relevant to the review's third research question.

TABLE 19: SUMMARY OF CONCLUSIONS AT THE ACTIVITY LEVEL

Case Study	Extent of Sustainability	Key Sustainability Factors	Extent of Replication or Scale-up	Key Factors for Replication or Scale-up
Zara Solar	High degree of sustained outcomes and commercial growth	Partnership with UNDP assists in the training of technicians that have contributed to responsive and high-standard customer service and maintenance practices.	Has not expanded out of Mwanza region; however, has consistently grown its customer base in northern Tanzania.	Geographically concentrated, however, grid-extension poses a risk for future expansion. Generating capacity of Zara systems will likely be in excess of the main-grid for several years. Target customers are well-off and upfront payment structure limits customer base.
EGG-Energy	Moderate sustainability; however, revised business model is likely to improve services to customer base	Moving away from battery-charging hubs that customers found inconvenient towards rent-to-own solar systems is a promising step to improve customer satisfaction as well as the overall customer base.	EGG has moved its geographic focus to Tanga and closed its original operations in Iringa.	Insufficient access to capital is cited as a constraint for expansion. Business model requires a critical mass of customers in each region it operates to consistently provide maintenance and support to customers.
M-Power	Moderate sustainability of systems but rapidly expanding customer base	Each of M-Power's customer financing schemes poses challenges. The target client though are lower-income customers therefore the potential user base is large.	Rapidly expanding geographic coverage (11 offices) and number of beneficiaries (from approximately 500 to nearly 12,000).	Streamlined business procedures allow for the straightforward set up of new offices that are able to operate semi-autonomously.

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

The review team considered the impact of contextual factors on the sustainability of DE systems. In Tanzania, one of the key contextual factors affecting DE activities is the government's new policies on grid expansion and increased grid access. In all three cases, grid expansion has some potential to reduce the company's customer base, depending on the government's ability to sustain expanded access to the grid. However, the impact of the grid may differ across companies, such that DE firms that compete directly with the grid are most at risk from grid expansion. Interviews with Zara Solar and EGG indicate that grid extension reduces sales, suggesting that their higher-end products may compete directly with the grid, whereas M-Power's lower-cost offerings target customers who cannot afford grid connectivity. Firm mobility matters also: Zara Solar's operations have thus far been limited to the Mwanza area due in part to the widespread availability of UNDP-trained technicians in that area; without a similar base of qualified technicians, expansion or relocation to other parts of Tanzania would be difficult, making Zara vulnerable to grid extension. EGG and M-Power, in contrast, have the flexibility to open offices in areas without grid access and, if needed, close offices. Flexibility to relocate to areas unserved by the grid is particularly important if the broader activity goal is increased access to electricity; companies with this kind of flexibility can change service territories to satisfy unmet needs even as the grid expands.

Macroeconomic conditions, particularly access to capital, affect all three firms. All reported that access to capital was crucial for growth and for replication, but found that lenders perceive their businesses as high-risk. Zara Solar found that a one-time influx of capital was sufficient. EGG and M-Power, however, require continued financing to provide payment flexibility to their customers and to fund the creation of new offices. M-Power has received sufficient investment funding and grants to open 10 new offices in the past year and a half; EGG has plans to expand to new regions once it obtains sufficient investment funds.

The effect of socio-economic factors differs somewhat across companies. Each company relies on existing institutions in some way. Zara Solar does not install or maintain its systems, and relies on the presence of technicians who were trained in association with UNDP-MEM. EGG makes use of existing associations such as agricultural membership organizations for marketing. M-Power uses existing transportation infrastructure. Across all cases, these firms are using locally available resources and adapting their business models to take advantage of regional opportunities.

These contextual factors and their impact on sustainability are summarized in Table 20.

TABLE 20: CONTEXTUAL FACTORS SUMMARY

Contextual Factors	Findings			Country-level Conclusions
	Zara	EGG	M-Power	
National Policies: Grid Expansion	Grid expansion has reduced sales.	Customers with grid access are less likely to pay.	Grid expansion might reduce customer base.	Companies that compete directly with the grid face more threats from grid expansion.
Macroeconomic Conditions: Shilling Depreciation; Poor Lending Environment	Access to capital is necessary for growth and expansion.	Access to capital is necessary for replication.	Access to capital is necessary for replication.	Access to capital is a challenge for DE firms. Ongoing access to capital or funding is crucial for companies that provide financing to customers.

Contextual Factors	Findings			Country-level Conclusions
	Zara	EGG	M-Power	
Socio-Economic Conditions	Training local technicians is crucial for success.	The presence of social organizations is crucial for the current marketing plan.	The company relies on the existing transportation infrastructure.	Successful and sustainable social organizations are often necessary for sustained DE outcomes.
Activity-Level Conclusions	The company has been sustainable to date, but may be vulnerable to changed conditions, particularly grid expansion.	Long-term sustainability and replicability may depend on the continued ability to adapt and access new capital.	The company's adaptability and affordability increase its long-term prospects for sustainability and replication.	n/a

Technical Approach Factors

While all of the cases examined in this report represent ES approaches, the form of this support provides instructive lessons for consideration.

Zara Solar received a series of loans from E+Co via the FENERCA Project. This is distinct from the grant support EGG and M-Power received through DIV funding. E+Co financed MMEE/Zara in keeping with its mandate to promote the development of renewable energy enterprises and projects. Loans dispersed from E+Co supported the creation of the Zara offshoot firm (distinct from MMEE), and facilitated bulk procurement of solar PV components that later contributed to Zara's ability to control price offerings available to its clients. All available sources confirm that the loans were repaid. The difference between this model and the other Tanzanian cases is that Zara was not seeking proof of concept or testing at scale funds - two purposes behind DIV grants. MMEE/Zara was an older firm, established in 1998, and sought entry into the renewable energy market. This interest was predicated on rapidly dropping costs of solar panels and a desire to meet consumer demand among the relatively well-off in northern Tanzania for reliable energy generation capacity. The loans were used as capital expenditure and were demand-driven in the sense that MMEE/Zara wanted to expand its operations through a commercial loan and had the capacity to repay it. Locally provided debt was difficult for MMEE/Zara to access likely due to the Tanzanian financial sector's unfamiliarity with credit underwriting for these types of investments. To conclude, the sectoral support that the FENERCA Project represents was able to successfully support an established enterprise that saw an opening in the market.

USAID ES support to EGG and M-Power had slightly different aims; meaning that the grants provided to these firms were designed to support their goals to rapidly expand offerings. While Zara is relatively dependent on its geographic foothold in northern Tanzania, EGG used its two DIV grants to first, pivot its business model away from battery-charging franchises in Iringa towards solar systems for individual and small businesses on a rent-to-own basis based out of Tanga. Second, DIV funding was shown to be instrumental in developing EGG's data capture, maintenance, and usage systems that has led to EGG's improved capacity to attract additional financing. EGG's entry into the market was roughly a decade after MMEE's; and their origin narratives illustrate the increasing sophistication (and opportunity) of the DE-sector internationally (e.g., greater liquidity and lower component costs), and increasing sophistication in the demands of Tanzanian DE-customers (e.g., a larger customer base of middle and lower income households expecting products with greater generating capacity than less-convenient battery-charging hubs). In essence, demand for scalable products is greater today than it was a decade ago. M-Power's experience was similar insofar that it used USAID-DIV grants to expand its operating budget and increase

its geographic coverage into new locations – providing training to a growing cadre of technicians and support staff.

Despite these successes, respondents from each of the firms said that access to capital remains a constraint on growth, signaling that USAID's well-received ES and sectoral support could be expanded.

Implementation-Specific Factors

Synthesizing field research findings across all three activities suggests that solar companies in Tanzania need to accomplish four main goals to be sustainable:

1. They must offer products that are both desirable and affordable to their target customer base;
2. They must attract a critical mass of customers;
3. They must limit financial risk to the company; and
4. They must maintain systems in good working condition.

Across the three cases, each firm developed strategies to achieve these goals, although the specific strategies have varied between companies and over time. This suggests that no single "model" is most likely to succeed; rather, successful companies will develop strategies to overcome challenges, risks, and hurdles associated with running a DE-related business.

Consistent with theory from the literature, certain activity implementation strategies – including community engagement, well-designed systems for fee collection and effective maintenance systems – are crucial for activity sustainability. All three cases engaged with local communities, particularly to identify customers' needs and to market their products to customers. An interesting theme from fieldwork was that approaches to community engagement take a range of forms. Zara Solar was seen as a company with extensive ties to the community, where community was defined as actors with long-term experience at rural electrification, such as policymakers, local non-governmental organizations and local business associations. EGG and M-Power, in contrast, do not appear to have close relationships with policymakers. Both engaged in village-level outreach as part of their initial marketing and planning activities; over time, both have phased out direct community outreach and moved toward marketing via mobile sales teams of local Tanzanian employees. Thus, community engagement is important for beneficiary uptake, but can take multiple forms, may change over time, and applies in different ways depending on a firm's business model.

Regarding maintenance strategies, the activity with the best record, Zara Solar, interestingly does not provide maintenance guarantees and is involved in maintenance only by connecting customers to qualified local technicians. The success of Zara's maintenance approach shows that in specific operating environments customers can take charge of their own maintenance. Yet, that this requires a fairly well-educated customer base and a network of well-trained technicians. EGG and M-Power's systems are designed to require less knowledge on the part of customers who simply call the company for maintenance. Both EGG and M-Power customers, however, reported delays and problems with maintenance, suggesting that these companies' business models may create incentives to focus on new installations over responsive after-sales service.

The Tanzanian cases suggest that strategies to increase affordability help support sustained outcomes. Affordability does however pose tradeoffs. For example, M-Power's systems are the most affordable, and accessible to low-income Tanzanians; yet these systems provide low levels of service that do not meet the gradually increasing expectations of its customers' energy needs. Zara and EGG's systems in contrast, support entrepreneurial activity, but are priced out of reach for most of the rural poor. Providing customer financing poses a similar set of tradeoffs since it usually adds (in the Tanzanian cases) to total system costs. As a result, customers who are able to afford systems outright (e.g., Zara Solar customers) pay the least for their systems. EGG's customers pay a premium to finance their systems, but in the end own the systems outright. M-Power's customers pay the least on a weekly basis, but customers voiced

concerns that the systems are too expensive in the long-run since they pay for years and never own the systems outright.

Finally, the single most important factor associated with sustainability and replication was the ability to adapt to changing circumstances. This will likely continue to be the case, as DE companies often face rapid changes in technology, policy, and other contextual variables. The ability to adapt in response to these changes is crucial for sustainability and scaling. These factors are summarized in Table 21.

TABLE 21: IMPLEMENTATION-SPECIFIC FINDINGS AND CONCLUSIONS

Factor	Findings			Country-Level Conclusions
	Zara Solar	EGG	M-Power	
Community Engagement	Engagement with national actors is crucial to success; contracts with local technicians are beneficial.	Local employees supplant initial high levels of community engagement.	Initial high levels of community engagement replaced by local employees.	Sustainable activities use community outreach to develop and market products; a range of approaches can work.
Anchor Institutions	N/A	N/A	N/A	N/A
Fee-Collection Strategies	Cash-only sales reduce company risk.	Credit checks and ability to shut off systems in case of non-payment reduces company risk.	Ability to shut off and repossess systems in case of non-payment reduces company risk.	Sustainable activities develop fee-collection strategies that reduce company cost and risk.
Systems for Maintenance	Use of local freelance technicians has been sustainable but not replicated.	Two-year warranty requires local technicians; long-term sustainability not yet established.	System to swap out and repair non-functioning systems works, but users experience delays.	Sustainable activities make provisions for maintenance.
Other: Activity Adaptability	Company has modified sales and finance strategies over time.	Company has modified product line and marketing strategies over time.	Company has modified marketing and sales strategies over time.	Sustainable activities have the flexibility and stability to adapt to changing conditions.
Other: End-User Affordability	Company targets customers with high incomes.	Company targets customers with high incomes and offers financing.	Company offers basic lighting services at low prices.	Sustainable activities find ways to make products affordable for a targeted customer base.
Activity-Level Conclusions	Activity implementation has been sustainable and has potential to grow, but is unlikely to be replicated.	Activity has been sustainable and is in early stages of replication; long-term success depends on access to capital and additional strategic partnerships.	Activity has been sustained and has replicated rapidly.	—

Findings Regarding Gender Equality and Women's Empowerment

Based on available documentation and respondent interviews, none of the DE investments covered by the Tanzania case studies were specifically designed, implemented, and monitoring to address gender empowerment – meaning they were designed to extend reliable, clean, and affordable energy access

through enterprise support and, to varying extents, were demand-driven. Despite this, this report identifies a few notable takeaways.

First, donors and enterprises at times approach gender empowerment from varied perspectives. Organizations that fund DE-activities — including USAID — have notable gender-sensitive programming guidelines.[14] EGG and M-Power reflected these reporting requirements in their USAID-grant milestone reports by discussing the gendered benefits that clean energy production provides (i.e., moving away from kerosene usage improves air quality in the home and disproportionately reduces the risk to women of respiratory illness and fire). Both enterprises also noted that they encourage female participation in the paid workforce by integration of female entrepreneurs into their distribution networks. Information was not available for the gender breakdown of either firm's employees. First and foremost, EGG and M-Power's chief objective is driven by commercial aims, i.e., profit. This motivation is often times complimentary to women's empowerment in the DE commercial sector because women make up half the customer base; however, complimentary is not the same as directly targeting gendered outcomes.

End-user interviews confirmed that energy needs differ between men and women, and small solar home systems are of limited benefit to women. Based on Tanzania fieldwork, the review team found that men typically make decisions about where lights will be placed (most systems only support two to three lights) and rarely locate them in the kitchen, where women would benefit most. Relatedly, female respondents expressed interest in energy generation for ironing, cooking, and refrigeration, which require larger (and more expensive) solar power systems. Despite a greater overall need for electricity, women in the sites visited by the review team were commonly excluded from decision-making about energy systems and often expressed limited understanding of how the systems work.

There were exceptions however. During one set of interviews with Zara Solar beneficiaries in Sengerema, and during another set of interviews with EGG customers in Tungalamenga, the review team spoke to multiple female beneficiaries who were the primary users of their systems and who expressed sophisticated understanding of their system capacities and maintenance needs. In both cases, this higher-than-normal level of women's empowerment seemed to be a combined function of favorable socio-economic conditions and a local technician who had made a special effort to educate and empower women to use their solar power systems. Beneficiary interviews were not intended to be representative; thus provide only a snapshot. Yet these anecdotes are still instructive about the potential sectoral benefits women's role in the DE-sector can bring and the effect prevailing gender norms within households have on the shared benefits of energy access.

Recommendations

Based on the above discussion and findings from the specific cases examined in Tanzania, the review team offers the following recommendations:

1) **USAID support to DE enterprises in contexts similar to Tanzania should be directed at helping companies adapt to rapidly changing circumstances.**

   Each of the enterprises profiled in this report confronted changing circumstances and required flexible approaches to adapt to new realities. Whether it the opportunity to expand into a promising market (Zara) or poor performing early business plans (EGG), each enterprise adapted to changing contexts and adjusted their approach. In the case of Zara, the firm recognized that reductions in the cost of solar technology posed an opportunity to fill the need for relatively well-off residents and enterprises in northern Tanzania. A decade later, EGG realized that batter-charging stations weren't fulfilling the needs of middle and lower-income customers and switched its offerings to a rent-to-own solar PV option. As the Tanzanian grid expands and customer

[14] For example, see USAID's 2012 Gender Equality and Female Empowerment Policy.

expectations become more sophisticated, enterprises will likely benefit from adaptive management and flexible approaches to expansion.

2) **Future USAID support to the Tanzanian commercial DE-sector should prioritize finance sector technical assistance in order to sustainably improve access to capital for DE-based companies.**

   Access to capital was cited by all three firms profiled in this report as a constraint to their continued growth. While USAID enterprise support, through DIV grants or through the FENERCA portfolio, was considered helpful and catalytic, the Tanzanian finance sector is unlikely to fill this financing gap in the near-term. Greater sectoral support schemes, as seen elsewhere in the USAID-DE portfolio would likely alleviate this constraint and sustainably improve domestic credit underwriting procedures for start-ups and established firms throughout the DE-sector.

3) **USAID should develop a standardized reporting framework and data repository for future investments, especially as they relate to data concerning the sustainability of outcomes for target beneficiaries.**

   Because sustainability and scale is a priority for USAID DE investment, a standardized reporting framework across investment approaches would likely improve the Agency's ability to retrospectively examine its programming and learn from past experiences. While DIV grants have a streamlined reporting structure and the FENERCA program was managed by a cooperative agreement, reporting expectations should be tailored to track factors contributing to scalability and sustainability. This may also include data pertaining to investment recipients' approach to gender inclusion and marketing efforts to both women and men.

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