

2015



1ST ANNUAL UN-DESA ENERGY GRANT



“Powering the Future We Want”:
Twelve Organizations that Reached the Top



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Acknowledgments



The United Nations Department of Economic and Social Affairs (UN-DESA) would like to express its gratitude to the 12 finalists that submitted inputs for this publication. In addition, to thank each representative who attended the Capacity Development Seminar in September 2015 for playing an integral role in the success of the event and for being instruments of capacity building and knowledge sharing to all of those in attendance.

UN-DESA would also like to thank the China Energy Fund Committee, an NGO with Special Consultative Status to UN ECOSOC, for sponsoring the USD \$1million energy grant; without this generous contribution the grant programme would not be possible. Thank you for encouraging and commending excellence in the field of global energy.

For more information please visit the grant website: <https://poweringthefuture.un.org/>

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Foreword



The United Nations Department of Economic and Social Affairs (UN-DESA) is working to address today's energy challenge, characterized by its social, economic and environmental dimensions. Worldwide 1.1 billion people still lack access to modern energy services and some 2.8 billion people rely on unsustainable biomass for cooking and heating. At the same time, energy-related greenhouse gas emissions contribute to climate change, accounting for almost 80% of GHG emissions in many economies.

The 2015 "Powering the Future We Want" UN-DESA Energy Grant highlighted noteworthy initiatives by innovative organisations that are making a positive and sustainable impact in this field. The Energy Grant Programme represented an opportunity to showcase some of the best examples that demonstrate how science, technology and innovation can be put into practice to induce change and to transform the world, bringing tangible benefits to the most vulnerable groups. This Grant Programme is a unique undertaking that focuses on the need for not only innovation and implementation, but also for capacity building, in energy for sustainable development.

The significant capacity building opportunity that the Grant Programme has created is a distinguishing feature, and this feature will continue as workshops, seminars and practitioner-to-practitioner training opportunities disseminate and transfer the knowledge and experience associated with the Grant. It is not only a million dollar Grant; it is a partnership effort to catalyse sustainable and meaningful change for our collective energy future.

I have deep gratitude to the Grant applicants, who have demonstrated through their initiatives and actions how they are contributing to the United Nations 2030 Agenda for Sustainable Development and the vision of Sustainable Development Goal (SDG) 7 "Ensure access to affordable, reliable, sustainable and modern energy for all". I also recognise the leadership and commitment of the China Energy Fund Committee (CEFC), whose funding support has made this Grant programme possible.

Reflecting on the success of the first year Grant initiative and on the number of very inspiring applications received, I am confident that this Programme will provide valuable support in the implementation of the 2030 Agenda for Sustainable Development and achievement of SDG 7.

More importantly, I am grateful for the visionary leadership and commitment of the winner and indeed of all the 12 finalists that made it to the top of the 2015 evaluation process and for their ongoing work in energy for sustainable development. We value their applications and we are heartened and inspired by the large number of initiatives on the ground.

Energy belongs to everyone on this earth, and access to sustainable energy should be secured for every man, woman, and child. We look forward to the implementation of the 2016 Grant Programme and to continuing this important initiative in the future.



Mr. Wu Hongbo

Under-Secretary General for
Economic and Social Affairs

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Abbreviations

BYD	Build Your Dreams
CREEC	Centre for Research in Energy and Energy Conservation
Capex	Capital expenditure
EFA	Eco-Fuel Africa
EII	Energy Inclusion Initiative
ERA	Electricity Regulatory Authority
EV	Electric Vehicles
IEWW	Informal economy women workers
KW	Kilowatt
kWh	Kilowatt hour
LIH	Low income households
MEI	MicroEnergy International
MEMD	Ministry of Energy & Mineral Development
MFI	Micro-finance Institution
MW	Megawatt
PHEV	Plug-in hybrid electric vehicles
PIH	Partners in Health
PV	Photovoltaic
SELF	Solar Electric Light Fund
SERC	Strathmore Energy Research Centre
SEWA	Self Employed Women's Association
SHS	Solar home system
SMG	Solar Market Garden™
SME	Small-medium enterprise
VAT	Value-added tax

I. Grantee Acceptance Speech, We Care Solar

By Laura Stachel, MD MPH

14 September 2015



Thank you to UN-DESA, Secretary General Ban Ki-Moon, Nikhil Seth, Wu Hongbo, Dr. Patrick Ho, General Assembly President Sam Kutesa, Grant Advisory Council and High-Level Steering Committee, and especially, thank you to all the heroic midwives, doctors, and other health workers, who are delivering babies and saving lives every night.

It is an honor just to be in this room – filled with people and organizations and so many cherished allies among the finalists, all sharing the vision of creating a world with sustainable energy for all.

I am overwhelmed and extremely grateful that the UN has chosen to offer its first “Powering the Future We Want” Energy Grant to an organization that is shining a light on an area of sustainable energy that has been largely overlooked – the lack of reliable electricity in health facilities.

This UN-DESA Energy Grant is for mothers. Mothers who cannot control how and when they will go into labor. Mothers who must choose between delivering at home, or traveling

miles through the night to a dark delivery room. Mothers who risk their lives with each pregnancy. Mothers who indeed sacrifice their lives every day from childbirth complications that are routinely treated in the American hospitals, where I delivered babies for decades.

No woman should die giving life.

This UN-DESA Energy Grant is for health workers: *midwives and doctors who overcome insurmountable obstacles such as broken equipment, insufficient supplies, and inadequate support ... in their efforts to provide life-saving care for mothers and their newborns.*

One of their biggest problems is also one of the easiest to solve. It is so obvious that it is routinely overlooked in studies and reports and commissions detailing how to reduce the unconscionable loss of life in childbirth.

Darkness.

In hundreds of thousands of primary health centers around the world, health providers show up to work in clinics without power, or with power that often goes out when it's needed the most, at night. They are not at the last mile. They are at the first mile. The front lines.

As an American obstetrician and a mother of three, I had always considered childbirth to be a joyous event, one to be celebrated. So it shocked me to witness deliveries in a Nigerian hospital in 2008, and to realize that the lack of reliable electricity was part of the reason that half a million women were dying every year from pregnancy related complications.

Can you imagine being a doctor and trying to conduct a Cesarean section in a room where the light could go out at any moment?

*Can you imagine being a midwife trying to maneuver a difficult delivery by candlelight?
Or having no light at all?*

And can you imagine - searching for resuscitation equipment in a darkened delivery room, while a newborn baby gasps for air?

Over the last five years, I have met hundreds of health workers in Africa, Haiti, and Asia. I have witnessed their working conditions, collected their stories, and shared their fears and their hopes. I have listened to midwives who have cried as they've recounted mothers and newborns they've lost when there was no light in the labor room, or no way to charge a cell phone to get emergency help.

We in this room know how to solve darkness. With light. And in particular from clean, healthy, and plentiful renewable electricity.

*What if we could put that solution in a box and get one to **every** health clinic? Perhaps we could just put it in a suitcase. That's what we are doing at We Care Solar.*

The Solar Suitcase is a compact yellow box that provides the first essential watts of electricity for a health center. We created a rugged 12 V DC solar electric system and paired it with highly efficient end appliances - medical lights, phone chargers, a fetal monitor. We designed it to be durable, portable, easy to install, simple to use, and hard to break.

It has traveled by truck, jeep, motorcycle, bicycle, horseback, donkey, canoe, and human heads and shoulders to reach some of the most remote health centers in the world. And it has enhanced care in labor rooms, operating theatres, emergency rescue expeditions, and relief tents, such as after the recent Nepalese earthquake.

I have seen the excitement and joy resulting from bringing a suitcase of solar lighting to a clinic. "I am not afraid to come to work at night anymore," says one midwife. "My problem is solved," says another. A third tells me, "This box you brought is a life-saver."

This UN-DESA Energy Grant IS FOR everyone in this room and all our partners who are united by three fundamental beliefs:

- 1. That women have the right to safe childbirth,*
- 2. That every health center is entitled to life-saving electricity, and*
- 3. That solar and sustainable energy technologies now give safe, reliable, and affordable solutions to this global challenge.*

This award can be a signal to global health care that the renewable energy movement is arriving with reinforcements.

There is so much work to be done. We need a variety of solutions, of different sizes and capacities to address the range of needs of health centers around the world. Many of the groups in this room have made great contributions to health care through their energy solutions, and are already part of this movement.

We need high quality, long-lasting, technology that can scale. We need low-power, highly efficient medical devices - such as vaccine refrigeration, blood banking, and x-ray machines that can run off of renewable power sources.

We need local capacity to ensure that renewable energy solutions are installed properly, used appropriately, and maintained over time. To that end, We Care Solar creates interactive training programs to develop a cadre of local solar installers, teachers and service technicians.

We need gender equity as part of the solution. At We Care Solar, we have cultivated a brigade of female solar ambassadors so that women are change makers as well as beneficiaries.

Finally, we need youth to be part of the solution. We Care Solar has launched a youth education program to inspire and train the next generation of solar innovators.

And we need investors and policy makers to ensure the success of this movement. There can no longer be silos between healthy childbirth and sustainable energy goals.

I thank UN-DESA for recognising that maternal survival is essential for economic and social development. When mothers survive childbirth, their infants are more likely to survive infancy, their children are more likely to attend school and be well nourished, their families are more likely to be productive and prosper. Our families and our communities depend on this.

I thank our staff, our board, and our volunteers. You are not afraid of challenges. You have shown how important it is to persevere and take action. In particular, I thank Hal Aronson, the co-founder of We Care Solar and my life partner. Hal saw the potential for creating small and robust solar electric kits for health workers.

You have shown that small things can lead to very big things.

Our first small things were made possible by the Blum Center for Developing Economies at UC Berkeley. We are grateful to them and the many foundations that have supported us as we have tackled bigger and bigger things.

I thank our donors – individuals and families who have joined with us to light up childbirth. I thank our partners - UN agencies, ministries of health, international NGOs and grassroot organizations. Your collaboration has enabled us to extend our reach and contribute to comprehensive improvements in maternal health care.

We thank the UN Foundation for its strong support, for spearheading the SE4All Energy Practitioner's Working Group, and for catalyzing greater linkages between sustainable energy and women's health.

And most of all we thank the health workers, who continue to care for mothers and their newborns under the most intolerable conditions. You inspire us.

Through our collective efforts, we have proven that it is possible to bring sustainable light and power to first mile health centers.

I hope this award can announce to the world that we have it within our capacity, and are thus duty bound, to light and power every primary health clinic in the world.

Together, we have the power to make this dream happen, and well before 2030.

Ban Ki-Moon told the world in 2012 that "Energy is the golden thread that connects economic growth, social equity, and environmental sustainability."

Today he connected that golden thread to education and health care.

Let's make that golden thread into a sunlit lifeline of hope for mothers and babies.

Thank you.

II. Introduction

At the United Nations Rio+20 Conference on Sustainable Development in 2012, world leaders, along with thousands of participants from governments, the private sector, NGOs and other groups, gathered to decide on a roadmap to eradicate poverty, and promote equality while respecting planetary boundaries.

At the Conference, Member States acknowledged insufficient progress in the promotion and integration of the three dimensions of sustainable development, and reiterated their commitment to this end. Among other thematic areas, energy was identified as one of the priority areas.

In September 2015, Member States adopted the 2030 Agenda for Sustainable Development at United Nations Headquarters in New York. The 2030 Agenda includes 17 Sustainable Development Goals (SDGs) and 169 inter-linked targets. SDG7 is a stand-alone energy goal that calls to ***"Ensure access to affordable, reliable, sustainable and modern energy for all."*** In the context of 2030 Agenda for Sustainable Development and recognising the importance of advancing implementation in sustainable development through partnership initiatives to address gaps in implementation, the UN Department of Economic and Social Affairs and the China Energy Fund Committee, agreed to collaborate on a joint programme "Powering the Future We Want: Recognising leadership and innovative practices in energy for sustainable development." The Programme promotes success stories and best practices in diverse priority challenge areas, including energy, food security and sustainable agriculture, sustainable cities and urbanization, and transport. As part of the promotion of best practices, which facilitates South-South sharing of experiences, US \$1million grants will be provided to individuals and/or institutions, which have demonstrated leadership and ingenuity in promoting sustainable development, for replication and/or scaling up.

Member States have encouraged the United Nations system to do more to identify and publicize best practices and lessons learned, in collaboration with Governments, business, civil society, and other stakeholders. In response to this call and to advocating for SDG7 on Energy, the Grant Programme was created with the aim of promoting best practices, while also featuring a strong capacity building component.

It was agreed to implement this initiative for an initial period of 5 years, from 2015 until 2019. The implementation process included the creation of a Grant Secretariat, an Advisory Council and a High-Level Steering Committee. For its first award, the UN-DESA Energy Grant received over 200 applications. The winner was selected through a rigorous review and objective assessment of these applications, undertaken in multiple stages, guided by the Advisory Council and High-level Steering Committee.

The 2015 Grant programme has been successfully implemented and the winner was announced at an Award Ceremony inside the United Nations Headquarters, New York on 14 September 2015. Secretary-General Ban Ki-moon gave opening remarks at the ceremony, where he described sustainable energy as a key priority for the United Nations that connects economic growth, social equity, a stable climate and a healthy environment: *"Energy underpins our efforts to achieve development objectives - from reducing extreme poverty to enhancing food security, from powering essential health services to providing electricity for education,"* he said.

Following remarks, the first ever US \$1million UN-DESA Energy Grant was awarded to We Care Solar, a non-profit organisation, to enhance and expand the use of its 'Solar Suitcase.' The Solar Suitcase provides off-grid health clinics in rural areas with solar power for critical obstetric and surgical lighting, mobile phones, fetal heart rate monitors and other essential medical devices. It thereby facilitates timely and appropriate emergency care, reducing maternal and infant morbidity in more than 20 countries in Africa and South Asia. In the last five years, We Care Solar, in close collaboration with local partners, has succeeded in empowering 5,000 health workers in the areas of solar energy utilization, installation and servicing to ensure the Solar Suitcases have a long-lasting impact. With the help of the Grant, We Care Solar will be able to bring the programme to scale, maximize the products' effectiveness, and build capacity.

After the Award Ceremony of the grant, the UN-DESA Energy Grant Secretariat hosted a two-day Capacity Development Seminar for the grant participants. The objectives of the seminar were to build capacities on best practices and successful implementation of sustainable energy development projects and programmes in developing countries, and challenges related to achieving global energy objectives including the Sustainable Development Goal 7 and targets on energy of the 2030 Agenda for Sustainable Development.

At the Capacity Development Seminar, the 12 finalists that reached the final stages of the application process were given the opportunity to disseminate their experiences and knowledge in the implementation of their projects and programmes. Representatives each gave statements and presentations to all participants, which included members of the Advisory Council, United Nations staff, representatives of Permanent Missions to the United Nations, international and national development organizations, and academia and students from universities.

III. 2015 “Powering the Future We Want” Grant Finalists

The 12 finalists that reached the top of the evaluation process represent a wide range of sectors, including the public and private sector, non-profit, research centres, women’s associations and micro-finance institutions. This group of 12 finalists is comprised of 11 independent organisations and one 3-way partnership, representing a total of 14 organisations. Each organisation maintains a unique set of expertise, while being bound by the common thread of a desire to increase access to modern energy services in an environmentally sustainable manner throughout the world.

The following section of this report highlights the mission and initiatives of each organisation. For these purposes, each of the 12 finalists have voluntarily submitted reports providing an introduction to the energy problem they seek to address; their approach to finding solutions; achievements made in the field; challenges along the way; and a discussion of future plans.

Through knowledge sharing and promotion of best practices, UN-DESA aims to encourage long-lasting partnerships and increase support for capacity development initiatives in energy for sustainable development by showcasing the commendable work of the 14 noteworthy international organisations.

a. We Care Solar 2015 Grant Recipient



Introduction

In hundreds of thousands of primary health centres around the world, health providers show up to work in clinics without power, or with power that often goes out when it's needed the most.

Pregnancy complications claim the lives of 287,000 women and over a million newborns each year, mostly in Africa and Asia. Mothers in the developing world die every day giving birth in dark and unsafe conditions. Midwives and doctors struggle to provide lifesaving care in health centres lacking electricity. The World Health Organization reported in 2013 that among eight sub-Saharan African nations, only 28% of health facilities had reliable electricity.¹

The consequences can be tragic. Childbearing mothers and their newborns often fail to receive timely care for emergencies because of inadequate supply of electricity.^{2 3 4}

¹ Adair-Rohani et al. Limited electricity access in health facilities of sub-Saharan Africa: a systematic review of data on electricity access sources, and reliability. *Global Health: Science and Practice* 2013, Vol 1, No. 2 *Glob Health Sci Pract* August 12, 2013 vol. 1 no. 2 p. 249-261

² M. Cham, S. Vangen & J. Sundby (2007): Maternal deaths in rural Gambia, *Global Public Health: An International Journal for Research, Policy and Practice*, 2:4, 359-372

³ Mbonye AK, Mutabazi MG, Asimwe, JB et al (2007): Declining maternal mortality ratio in Uganda: Priority interventions to achieve the Millennium Development Goal, *International Journal of Gynecology and Obstetrics*, 98, 285-290.

⁴ Orji EO, Fasubaa, OB, Onwudiegwu, FO Dare, and Ogunniyi S.O. Decision-Intervention Interval in Ruptured Uteri in Ile-Ife, Nigeria. *East African Medical Journal*, 79:9, 496-498.



Midwives struggle by kerosene lantern or candlelight to provide care, unable to detect life-threatening conditions or provide necessary services, and sometimes postponing or cancelling life-saving procedures. Cesarean sections are delayed and critically ill patients are often turned away from hospitals lacking power. Midwives may be unable to adequately assess newborns for complications, birth defects, or asphyxia.

Even health centres connected to grid power can be crippled by darkness during evening hours, as overstretched grid operators shed loads with rolling blackouts. Clinics with generators often lack the funds for daily fuel and maintenance. Health centres without any source of power rely on substandard and hazardous sources of light, such as kerosene

lanterns and candles that offer inadequate illumination for medical procedures, emit smoke with deleterious health effects, and increase the risk of fire and injury.⁵ Midwives in some countries request funds from patients for kerosene, candles or batteries, and many women stay home during labour to avoid these charges.⁶

Prevailing Challenges in Energy Solutions for Health Centres:

- Reliance on fossil fuel solutions such as diesel fuel generators prone to breakdown and costly to maintain;
- Electrification of health facilities has fallen between ministry "silos" and has had low prioritization by governments and development agencies;
- Solar electric systems are often poorly designed, require expensive maintenance, and are prone to failure;
- There is a lack of local knowledge and training about solar electricity; and
- There has been a general lack of global awareness that health facilities are without reliable electricity and that feasible and affordable solutions are available.

Approach

We Care Solar aims to reduce maternal and perinatal mortality by addressing the challenge of poor to non-existing energy provision in maternal health facilities.

We Care Solar is a non-profit organization co-founded by a husband-wife team: obstetrician Laura Stachel and solar innovator Hal Aronson. The couple began designing solar electric solutions for maternal health in 2008, when Dr. Stachel's public health research in a Nigerian hospital revealed that energy poverty was linked to maternal mortality. Without electricity, doctors and midwives struggled to provide timely and appropriate maternity care using kerosene lanterns and candles, sometimes postponing

⁵ We know of two examples of maternal health centres that have burned down from candles used at night. In one case, two patients died from the fire. And numerous midwives have described how they have accidentally burned mothers or babies during labor or delivery with candle wax.

⁶ From interviews with midwives by Laura Stachel in Malawi, Nigeria, and Uganda.

and cancelling critical procedures or turning patients away from the hospital. Mr. Aronson designed four stand-alone solar electric systems for that hospital, targeting the operating theatre, labour room, maternity ward, and laboratory (for a blood bank refrigerator). In the next year, the hospital had a marked drop in maternal deaths and an increase in obstetric admissions. Word spread about the transformation at the state hospital, and nearby health centres began asking for solar power, lamenting that they had no lighting at night for maternity care. We Care Solar needed a solution that could be brought to scale.

We Care Solar has systematically addressed the challenges to health-clinic electrification by:

- Designing a rugged, reliable solar electric system for health workers in harsh environments that is easy-to-use and requires minimal maintenance;
- Providing training programs to build local capacity in solar installation, usage, and maintenance;
- Partnering with health ministries, local and international NGOs, aid agencies and solar energy providers to deploy Solar Suitcases to remote health centres;
- Working to ensure that reliable electricity for health care is on the global health and sustainable energy agendas by engaging key policy makers and influencers; and
- Demonstrating that basic lighting and electricity are feasible and affordable for all health clinics.

The We Care Solar Suitcase®



The We Care Solar Suitcase is a complete and compact solar electric system that provides medical lighting, cell phone charging, headlamps, and a fetal Doppler (for heart rate monitoring). Packaged in a water-tight case that doubles as a cabinet for permanent mounting, the system is designed for transport to remote locations. It includes solar panels, a solar charge controller, a sealed battery, and the hardware needed to facilitate installation. The Solar Suitcase can be expanded to accommodate larger solar panels and batteries, allowing it to power laptop computers and/or medical devices.

Achievements



Over 600,000 Mothers and Infants in Health Centres Served

By delivering solar power to last-mile health centres in countries, where health care infrastructure is poor and electricity is lacking, We Care Solar has enabled thousands of midwives and doctors to provide lifesaving care. In the last five years, more than 1,500 Solar Suitcases have been shipped out to 30 developing countries, partnering with leading international NGOs, UN agencies, and development organizations. The medical LED lights replace candles, kerosene lanterns, and diesel generators, reducing CO₂ emissions and the risk of fire. We Care Solar has trained more than 5,000 health workers and local technicians on the proper installation and maintenance of the system to ensure the sustainability of the programs.

The Solar Suitcase provides around the clock lighting for deliveries and caesarean sections, as well as enables fetal heart rate monitoring and improves the capacity of health workers to diagnose and treat childbirth complications. It increases the utilization of skilled care for maternal health, improves health worker morale, and even provides cell phone charging for emergency referrals.

Impact Summary



1.5 million hours of nighttime medical lighting provided by Solar Suitcases



1,300 Health Centres equipped with Solar Lighting and Essential Power



9,238 tons of CO₂ averted by using energy from Solar Suitcases instead of fossil fuels



600,000 Mothers and their infants now served in health centres with reliable power.



25 Partnerships with leading development organizations like UNICEF, WHO, and Pathfinder International

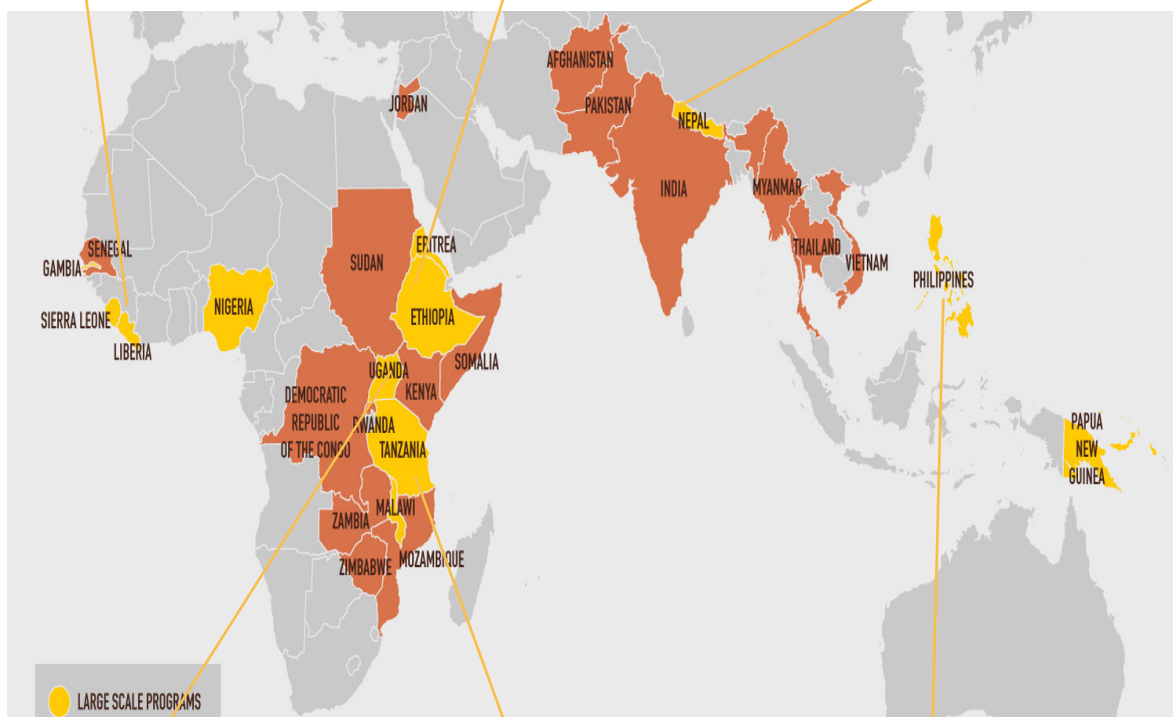


5,000 People Trained including health technicians and installers

We Care Solar’s partnerships with more than 25 organizations are a key factor in the effectiveness of their programs and in scaling impact. We Care Solar is unique in that it is designing/manufacturing a technology product and also developing distribution and service delivery models in partnership with other institutions.

Examples of partnerships are shown on the map below.

<p>SIERRA LEONE Continuing to equip health centres with light post-Ebola in collaboration with UNFPA and Medical Research Centre.</p>	<p>ETHIOPIA Equipped 190 health centres with Solar Suitcases in partnership with Hamlin College of Midwives and WEEMA International. Initiating additional partnerships in 2016.</p>	<p>NEPAL In response to the 2015 earthquakes provided 110 Solar Suitcases to maternity clinics and temporary birthing tents in partnership with One Heart Worldwide. Will be working with additional partners in 2016.</p>
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<p>UGANDA More than 300 Solar Suitcases were installed in partnership with UNICEF, AMREF, Save the Children, Pathfinder International, and Ugandan Private Midwives Association.</p>	<p>TANZANIA Supported more than 78 health centres in two districts in partnership with Pathfinder International.</p>	<p>PHILIPPINES More than 200 Solar Suitcases were deployed in this disaster-prone region in partnership with Stiftung Solarenergie Foundation. A repository of Solar Suitcases is being established for future emergency relief efforts.</p>
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Challenges

Regulatory Challenges

Efforts to upgrade battery technology have resulted in significant shipping challenges. International shipping regulations fail to differentiate safer lithium ion batteries, such as We Care Solar's Lithium Ferrous Phosphate battery, from more dangerous lithium metal batteries. This means that these batteries are now considered "hazardous goods." Shipments are subject to greater scrutiny and increased costs. The immediate solution has been to spend additional time and costs on logistics and shipping. But every dollar of added cost and day lost in shipment is a dollar taken away from beneficiaries.

Importation Challenges

Other logistical challenges include variable import regulations between countries and even within the same country. Shipments have been delayed in customs because of changing regulations within a given country. We Care Solar has also been asked to pay value-added tax (VAT) to some governments, even though it is a non-profit organization making humanitarian donations. Addressing these regulatory challenges on a case-by-case basis has been resource intensive. The organization has been working with government ministries to obtain exemptions from VAT, but in some cases this has taken months.⁷ Other non-profits that We Care Solar has consulted with face similar barriers.

The Challenge of Sustainability

Developing a robust servicing plan for installations has proven to be a challenge that relates to long term sustainability. This is a common challenge for organizations introducing institutional technologies – including solar electric systems – to regions with poor infrastructure. The developing world is replete with failed solar electric systems in health centres. Some were designed poorly at the outset or used cheap equipment, others required regular maintenance by health workers either not trained or not equipped with appropriate supplies (e.g. distilled water for flooded batteries), and others required expensive battery replacements. Often it appears that health workers do not know where to turn, when equipment failures occur. In experience, district health technicians are often under-resourced, and may not have the finances, equipment, transportation budget, or technical knowledge to address the needs of health centre equipment.

We Care Solar is addressing this challenge in several ways. The robust solar electric system was designed to have minimal requirements for maintenance, and the new batteries will reduce this requirement further. Another solution is developing remote monitoring capacity for the next generation of Solar Suitcases to give timely information about the performance of systems. Training programs provide local health workers and technicians with the knowledge to change batteries and trouble-shoot potential problems. Also establishing Memoranda Of Understanding and contracts with district health agencies and/or our local partners to set aside funding for replacement batteries over time. There are plans to test different models of servicing over time, including the option of employing local companies to provide service contracts for long-term

⁷ For example, for a program being conducted in the Philippines to equip maternity clinics affected by Typhoon Haiyan, Solar Suitcase shipment was held up for nine months as We Care Solar waited for appropriate paperwork from governmental agencies.

maintenance. And lastly, developing stronger supply chains to ensure that high-quality replacement parts are available, when they are needed.

Creating International Partnerships to Reach Scale

Finally, We Care Solar faces a challenge in that primary headquarters are based in California, and programs are conducted internationally. Solar Suitcases and training workshops are provided to build local capacity, but heavy reliance remains on partners to implement programmes. While this model has been reasonably effective in smaller programs, it is proving to be more challenging to identify partners that can effectively implement programs serving 100 or more health centres at a time. As a Bay Area company producing a technology product with related services, growth could occur more quickly, if partners had the necessary infrastructure or willingness to scale.

We Care Solar is addressing this challenge by reviewing organizational “best practices” and creating clear guidelines for potential partners. In some countries, a Request For Proposals process is used to identify organizations that can help scale. Additionally, We Care Solar is working to retain contractors in countries like Ethiopia, Uganda, and the Philippines that can interface with partners from a closer distance.

Future Plans



We Care Solar is committed to making solar energy accessible, affordable, and sustainable for global health needs, and advancing the use of solar electricity in under-resourced health facilities to improve maternal and child health outcomes.

The need for electrification of rural health facilities is great, and We Care Solar is increasing the scale of our operations to address this need.

To reach scale, We Care Solar is:

- **Planning for greater impact** in selected high-priority countries with high maternal mortality and low electrification. By deeply penetrating selected countries, We Care Solar can build greater infrastructure, allowing the implementation of high-volume programs on a regional or national level. In these countries, continuing to work closely with carefully selected partners to build

capacity using the train-the-trainer approach and will monitor and evaluate the impact of these programs.

- **Developing regional training programs** to enable organizations outside of the strategic target countries to gain the knowledge and skills to implement Solar Suitcase programs.
- **Designing curriculum and videos** in several languages to enable individuals and smaller organizations to conduct Solar Suitcase installations with minimal technical support.
- **Expanding adjacent markets** by addressing the need for robust compact solar electric systems for emergency and relief work.
- **Championing energy solutions** among global health policymakers and funders and promoting health care opportunities among sustainable energy advocates and investors.



While We Care Solar plans to continue rapid growth to 20,000 Solar Suitcases by 2018, this is still just a fraction of the global need. Though the Solar Suitcase is an appropriate primary technology for rural maternity wards and can provide back-up lighting for hospital delivery rooms and operating rooms, We

Care Solar will continue to advocate for a range of solar solutions to meet the needs of health facilities of different sizes and capacities.

b. BYD (Build Your Dreams) Auto Co. Ltd.

Winner of Special Recognition 2015



Introduction

Over the last 30 years, consumption of fossil fuels has been 1 million times faster than the rate of their natural formation. Therefore, sustainability was quickly placed at the very top of BYD's company agenda. BYD assessed that petroleum, natural gas, uranium and coal supplies, being finite, will soon pose a serious threat of energy crises to civilization. BYD asks: Should we wait for all these reserves to peter out? Do we really need to use them all up? What about the deadly by-products of their usage, chiefly CO₂ emissions and PM2.5? The former is responsible for the greenhouse effect that raises global temperatures that will soon enough be irreversible, if we do nothing; the latter, for a gargantuan threat to human health and a death toll of tens of thousands every year. Only 1% of city dwellers in China live within acceptable PM2.5 levels (40µg), and 60% live above critical levels (60µg). However, the WHO's maximum rate of PM2.5 density is only 20µg/m³. If PM2.5 density rises above 20µg/m³, it can substantially raise the death toll from pollution related diseases. As for CO₂ emission rates, if present trends continue, the melting of polar ice caps and glaciers, resulting from global warming, will raise sea levels that will submerge countless coastal cities, among a plethora of other disgraceful consequences to the planet. From 1906 to 2005, the Earth's temperature rose by an average of 0.74°C – a rate of 0.2°C per decade. From 1951 to 2009, China's ground temperature increased by around 1.38°C, at a rate of 0.23°C per decade.

Approach



With energy storage as its core competence, it was only natural for BYD to channel its efforts towards clean and renewable energy, given the dire contingency of current energy demand, fossil fuel dependence and the devastating environmental results of its use.

The question for the company then became: How can we tackle this pressing issue most effectively? It was only natural that the company turned to transportation, the largest source of city emissions, accounting for up to 60% of all carbon gases. BYD's greatest effort then was to work out a solution to help cities completely eliminate such emissions. With 1/3 of transportation emissions coming from public transit buses and taxis, another 1/3 from refuse trucks and other kinds of delivery trucks, and the remaining 1/3 from private vehicles; by electrifying buses, taxis and trucks 2/3 of these emissions could be *immediately* wiped out, in addition to substantial fuel and maintenance savings along the process. With 2/3 of emissions coming from less than 10% of the vehicles running on the roads, BYD decided to prioritize this mode and set out to develop a zero-emission Electrified Public Transportation platform in the form of bus and taxi fleets to be adopted in municipalities, so that their impact would be most significant, and EVs – still a far-fetched reality – would reach the masses, instead of fewer individuals, who could afford them, and whose impact would still be meagre.

Founded in 1995 as a battery manufacturer, BYD Company Ltd. has grown into one of China's largest private companies to have successfully expanded globally. By consistently improving its energy storage technologies with extensive and relentless R&D, its green mission to holistically tackle the GHG issue has made it an industry pioneer and leader in several high-tech sectors, chiefly High-efficiency Electrical Vehicles (EVs), Electrified Public Transportation, Renewable Energy Storage, Affordable Solar Power and Information Technology.

Achievements

The company is currently the world's largest manufacturer of rechargeable batteries. Its mission to create safer and more environmentally friendly battery technologies has led to the development of the BYD Iron Phosphate Battery – a fire-safe, completely recyclable, remarkably long-cycle and long-life energy storage solution that has become the core of its clean energy platform, expanding into automobiles, buses, trucks, utility vehicles and energy storage units. BYD and all of its shareholders, among them American investor Warren Buffett, see these environmentally necessary and economically forward products as the way into the future.

BYD's electric buses and taxis started operating in the Chinese city of Shenzhen in 2010. The city currently relies on a BYD fleet of 780 buses and 850 taxis, with another 3,600 buses and 3,000 taxis to be delivered by the end of 2015, totaling a fleet of 4,380 buses and 3,850 taxis, all zero emission. The city's fleets' accumulated mileage is 452,050,000 km, representing a cut of nearly 185,000 tons of CO₂. This achievement granted Shenzhen the C40 Award in the transportation category in 2014. The city has plans to electrify its entire public fleet of 15,000 buses by 2017. Several other Chinese cities followed suit, most notably the city of Nanjing, with a BYD fleet of more than 1,500 vehicles between buses and taxis, and an accumulated mileage of 31,340,000km or a 33,082-ton cut in CO₂. In 2015, it was Nanjing's turn to be awarded the C40 Transportation Category Award. Today, BYD's Electrified Public Transportation

solutions are running in over 160 cities worldwide, totaling around 5,100 buses and over 12,000 taxis, with an astounding overall mileage of 495,467,384km by October 2015. Such mileage run by public EVs means that 87,880,390 liters of fossil fuels were saved and over 220 million tons of CO₂ did not hit the atmosphere.



But the company sees no point in producing EVs and energy storage systems without making sure that the energy charging its batteries is clean and renewable, so its next step was to deploy its massive R&D and manpower resources to create a Zero Emission Energy Ecosystem comprising affordable solar power generation, reliable and effective energy storage, and cutting-edge electrified transportation.



Over the last five years, with its state-of-the-art solar modules, BYD has delivered well over 1.5GW in solar projects in Europe, America, the Middle East, Africa and the Asia-Pacific region. The company also offers different types and sizes of energy storage systems for homes, communities and industries to make sure more and more users have access to clean and stable solar power. BYD has delivered over 200MWh in energy storage systems globally, and ranks first worldwide in installed Grid-Tied energy capacity.



Challenges

The rise of electrified transportation still faces a series of challenges, but BYD perseveres in finding ways around such challenges:

1. **Challenge:** Electric vehicles (EVs) still face serious challenges to becoming widespread and accepted by the general public. There is still a great deal of scepticism regarding vehicle performance, reliability and driving range.
 - **Solution:** BYD's technological strides have gone a long way towards extending driving ranges to quell the general public's range anxiety – the latest generation of the BYD e6 crossover sedan runs 400km on a single charge. Its latest PHEV private car models feature the BYD 542 performance initiative, in which “5” means the vehicle's power to reach 100km/h in less than 5 seconds, “4” meaning four-wheel drive, and “2” for its fuel efficiency of 100km with less than 2 litres of gasoline.
2. **Challenge:** Developing a solid charging infrastructure to quell consumer's natural – but often unfounded range anxiety.
 - **Solution:** In addition to developing faster charging alternatives and vertical charging solutions like the charging carousel (for 12 vehicles) and the charging tower (for 400 vehicles), BYD establishes partnerships with governments - charging infrastructure integrates the Chinese Government's sustainability agenda - and involves the private sector for implementation and management.
3. **Challenge:** Due to their relative novelty, EVs are still steeply priced, even though there is a tendency to become increasingly more affordable, like with all new technologies. Thus, there is need for governments to step in with financing, industrial support and market subsidies to promote the development, dissemination and marketing of EVs. Many governments worldwide are swiftly adopting such policies, but others seem to be taking a little longer. BYD believes that unless public administrations take bold and quick action to promote transport electrification at this early stage, they will be jeopardizing their sustainable development agendas.
 - **Solution:** In order to comply with previously set sustainability targets, the Chinese government has consistently taken bold measures to tackle environmental degradation with a series of policies favouring development, production and marketing of what is known in China as “New Energy Vehicles”, with countless benefits to the industry, the population and the environment.
4. **Challenge:** Financial institutions must embrace sustainability as a sound and feasible economic model – in spite of a certain degree of risk, just like any other

venture – at a time when economies are increasingly shifting to such practices as an inescapable alternative to confront impending environmental crises.

- **Solution:** Given the importance and increasing popularity of sustainability not only for governments, but also businesses in general, financial institutions' interest in the agenda is growing and it is becoming increasingly easier to obtain financing for sustainable development.
5. **Challenge:** Public transport fleet operators are wary and unwilling to undertake the considerably higher investments and adaptations necessary to make the transition to a sustainable transportation model.
- **Solution:** Once operators understand that their fuel and maintenance costs will be substantially reduced by adopting electric vehicles, and that Return On Investment will take place fairly soon, it will become easier to make the case for electrified fleets. Success cases of fleet electrification worldwide have also largely contributed to changing short-term-cost mentality.
6. **Challenge:** Battery output capacity may be insufficient to supply the increasing demands not only for EVs, but also energy storage systems. As demand increases, so does the risk of bottlenecks.
- **Solution:** BYD has already increased its Iron-Phosphate Battery output capacity from 2GWh to 10GWh, with the recent completion of its state-of-the-art Kengzi battery plant. The company has also plans to further expand its capacity to 16GWh in the near future.

Future Plans



BYD Company Ltd. envisions it will have an indispensable role in achieving sustainable development. Its “Three Green Dreams” – or more technically speaking, its Zero Emission Energy Ecosystem – are really close to materialization, with increasing global participation in solar power generation and storage as an addition to its outstanding results in transport electrification. The global focus has been increasingly put on the negative impact of climate change. To help overcome this threat, BYD is decisively aiming to promote sustainability with improved technologies, streamlined products, and outstanding propositions.

The current historical rise of EVs worldwide comes together with the rise of the Chinese auto industry and that of BYD's. The company's EV strategy is not limited to Electrified Public Transportation or mere passenger vehicles, in spite of its outstanding performance in both these categories. BYD is also well on its way to accomplishing its 7+4 strategy, which epitomizes its ambitions for the future of "new energy vehicles," where buses, taxis and passenger cars would be just part of a much bigger picture. The company aims at electrifying all possible means of terrestrial transportation: the "7" stands for major conventional vehicles, comprising buses, coaches, taxis, private cars, urban logistics trucks, sanitation trucks and construction trucks (concrete mixers); and the "4" stands for specific off-road environments: warehouse, mining, airports, ports. The company's recent rise in Plug-in Hybrid EVs has been as inconspicuous as its massive presence in Electrified Public Transportation worldwide.



Additionally to its industrial and market achievements, for several years BYD has been actively participating in UN climate change initiatives with its maturity and expertise in the areas of Electric Vehicles and Renewable Energy. The company sees these partnerships and contributions as a way to disseminate the benefits of clean energy and contribute to a safer and improved future.

c. Eco-Fuel Africa

Introduction

Eco-Fuel Africa is based in Uganda, where 93% of the primary energy supply comes from wood-based fuels, and the total energy demand is expected to double by 2025 (Khundi et al, 2010). Uganda has already lost 75% of its forests, and under business-as-usual, the country will have no forests left within 25 years (NEMA, 2009). As forests disappear, marginalized households have to spend up to 40% of their incomes on dirty wood-based fuels. This worsens poverty levels.

In January 2009, Sanga Moses, the founder of Eco-Fuel Africa (EFA), travelled from Kampala, the capital city of his native country, Uganda where he worked as an accountant in a top bank to go and visit his mother in his home village in Western Uganda. On his way home, he met his 12 year old sister carrying a huge bundle of firewood on her head.

She had missed school that day and walked for 10 kilometres to gather firewood for her family. When his sister saw him, she started crying and told him that she was tired of missing school to gather wood. This troubled Sanga so much, because he was paying school fees for his sister and wanted her to get an education.

Sanga immediately decided to quit his secure job and, with just \$500 in savings, to totally focus on finding a solution to the overdependence on fuel-wood issue in Uganda. Everyone thought he was crazy! He spent a full year researching possible solutions until he realized that he could turn agricultural waste, which is abundant and wasted in Uganda, into clean burning fuel briquettes.

He sold all his personal belongings, including his bed, to build the first kiln and make the first briquetting machine. In April, 2010, Sanga launched Eco-fuel Africa and in November, 2010, Eco-fuel Africa brought its first product to market.

Approach



Youths carbonizing waste for income

Uganda has enough biomass waste needed to make the solution successful. Uganda's agricultural sector produces about 7.9 million tons of crop residues per year (UNEP, 2001). Given that briquettes are equivalent in energy to wood charcoal, and that Uganda's charcoal consumption is about 850,000 tons annually (UN-DESA, 2010), the company can extrapolate that the entire wood charcoal market could be replaced by converting just under half of available crop residues into briquettes.

EFA works by training marginalized farmers to turn locally sourced biomass waste into a product called char using simple, locally made kilns. These farmers receive a five-day long training and after its completion, they take home a kiln on a lease-to-own basis, and begin to make char out of waste sourced locally from their communities.

About 80% of this char is sold directly to EFA or to its micro-franchisees. Each farmer earns at least \$30/month from selling char to EFA, an activity that is augmenting incomes of marginalized farmers by over 50%.

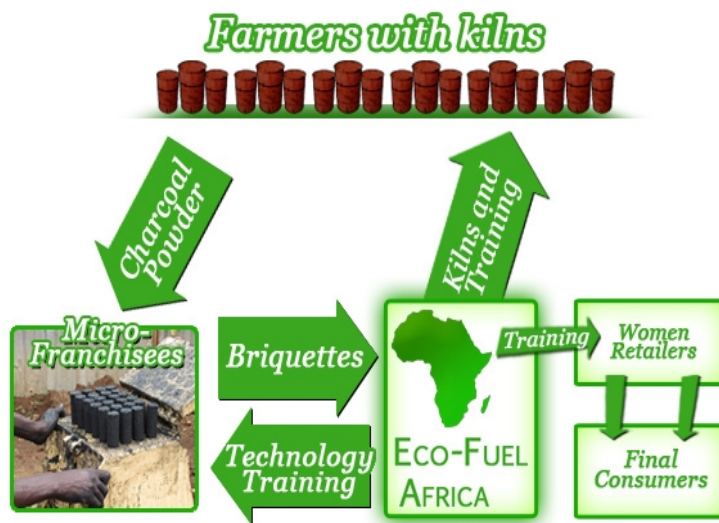
The char that farmers do not sell to EFA, which is about 20% of the char they make, is retained by the farmers and EFA trains them to mix it with local organic nutrients to make biochar, which they then put in their gardens to increase their agricultural productivity. This has helped over 3,500 marginalized farmers in Uganda to increase their food harvests by over 50%. This has reduced malnutrition, increased food security and increased incomes of farmers.

EFA then presses the char bought from farmers into green charcoal; a carbon neutral cooking fuel, which functions the same as traditional fuel-wood but costs 20% less, is not smoky, and burns longer than fuel-wood.

EFA then sells its green charcoal back to communities through a network of women retailers. EFA selects these women retailers through partnerships with local women's groups. Selected women are trained for 3 days and at the end of the training, EFA builds a kiosk for each of the women, which they use as a retail shop to sell EFA's green charcoal in their local communities. Already, EFA has created a network of 2,300 women retailers in Uganda. Each of these women retailers earns at least \$152/month. This is augmenting incomes of marginalized women by over 100%.

In areas where EFA cannot operate directly, it empowers local people to replicate its model in those areas through a program called **micro-franchising**. Through this program, Eco-fuel Africa works with community-based organizations and NGOs to identify local marginalized people, particularly women and youth, who are then trained and given the initial machinery needed to launch a briquetting micro-factory in their village, on a lease basis. These village factories are owned and managed by the micro-franchisee; EFA only plays an advisory role and generates revenue through leasing the technology to the micro-franchisee, and training fees. Already 200 micro-franchises have been created. Micro-franchising overcomes the need to transport the fuel briquettes over very long distances, keeps the cost of fuel briquettes down and creates a revolutionary growth opportunity for village-level micro-scale bioenergy entrepreneurs.

Below is a visual summary of Eco-Fuel Africa's business model:



By decentralizing production of fuel briquettes, Eco-Fuel Africa is able to create many sustainable jobs for people at the base of the pyramid that are normally not reached by other development initiatives through capacity building. The technology is tailor-made to ensure that local people with no or limited education can use and maintain it. The company also provides comprehensive business training and mentoring to micro-entrepreneurs to ensure that they have the skills needed to manage their briquetting micro-businesses.

Also, empowering local communities to be in charge of producing their own fuel briquettes, gives them ownership of the project. The goal is to ensure that communities see this project as theirs. Experience shows that when local people feel involved, they are very determined to ensure that the project's success. Eco-Fuel Africa has seen community leaders and everyday people become strong advocates against deforestation in their communities, because the company involved them in this initiative.

Achievements



Sustainable jobs for women

Launched in 2010 with just USD \$500 in personal savings, EFA currently serves over 56,000 households on a daily basis in Uganda; has created over 5,800 jobs for people at the base of the pyramid; has enabled over 20,000 marginalized girls to enrol and stay in school, and has created over 50 million hours for working and studying for marginalized women and girls in Uganda. Eco-Fuel Africa has also been able to reduce deforestation and indoor air pollution in the areas where it operates. Customers also save money by using the briquettes, instead of charcoal from wood, because EFA briquettes cost 50% less. With these cost savings, households are able to send their children to school, and generally improve their household conditions.

Challenges

Financial: Raising capital has been a challenge. Banks charge very high interest rates and ask for a lot of collateral security that organizations like EFA do not have. Alternative forms of capital are simply non-existent, which limits EFA's ability to expand rapidly.

Currently, EFA's biggest challenge is that supply cannot meet the high demand due to lack of finances needed to rapidly expand production capacity. Organisations like UN-DESA should continue to mobilize funds for organisations working in developing countries.

Lack of Infrastructure: Uganda's underdeveloped infrastructure makes EFA's operating costs very high. For example, the road network is poor, which makes transporting products very expensive. In addition, electricity supply is not available in most areas, and where it is available, it very expensive and unreliable further hindering the expansion of production capacity.

Local governments in developing countries should continue to work on improving infrastructure and making the business climate in these countries more conducive for entrepreneurs, like Eco-Fuel Africa.

Future Plans



User of eco-fuel briquettes

Eco-Fuel Africa's plan is to replicate its solution first in all Sub-Saharan African countries, and then in other developing countries like India.

EFA mainly targets marginalized communities, where often most potential beneficiaries cannot cover the upfront costs. To overcome this barrier, EFA aims to create a revolving loan fund, which will allow groups of women and youth to replicate the solution in their local communities. The revolving loan fund will enable EFA to provide initial funding to new clean energy micro-entrepreneurs by loaning the technology to them.

Beneficiaries will be identified and vetted through partnerships with community-based groups, NGOs and organized cooperatives. Partner groups/ organizations will be asked to nominate eligible members. EFA will mainly target marginalized groups particularly widows, single mothers, unemployed youths and people with disabilities.

Funds recovered from old entrepreneurs will go back to the fund to replenish the reserve, which will then enable EFA to engage with new micro-entrepreneurs in new areas. The strength of this idea lies in the fact that once it's launched, it will be able to perpetuate without further external funding.



Women micro-retailers

The revolving loan fund will generate many sustainable jobs for people at the base of the pyramid in Sub-Saharan Africa. Based on past experience, each micro-franchisee will need to engage at least 100 local households with kilns, which will supply the charcoal powder needed to manufacture green charcoal. Each of these households will earn at least \$30/month in extra income from the kiln.

Also, each micro-franchisee will need to create a network of at least ten women retailers, who will sell the green charcoal to local consumers in the villages/ slums

surrounding the micro-franchisee. Each of these women retailers are expected to earn at least \$152/month.

Each micro-franchisee will also directly employ at least three local people, particularly women and youths, in marginalized communities in Sub-Saharan Africa.

As a result, each micro-franchise will provide access to at least 5,000 people (833 households) to clean cooking fuel, as an alternative to fuel-wood, thus reducing deforestation and the impact of climate change as well as enabling young girls to stay in school, instead of skipping school to gather wood.

Also, once EFA creates a revolving loan fund to help new micro-entrepreneurs finance the initial costs needed to launch community-based micro-franchises, the project will be able to perpetuate with no or limited external funding. This is because micro-entrepreneurs will be able to immediately start making money and therefore, will immediately be able to start paying back the initial micro-loan that is invested in them and the interest on these micro-loans. The principle recovered from these micro-franchisees will go back to the revolving loan fund and will be used to create more micro-franchisees in new areas while the interest will be used to pay for operational costs.

Through this, EFA hopes to rapidly expand and be able to bring clean cooking fuel to at least 100 million energy poor people in Sub-Saharan Africa by the year 2030.

EFA is looking for partnerships with impact investors and other like-minded organizations. EFA is also looking for partnerships with women and youth groups in East Africa that could benefit from the micro-franchising program.

d. Powerhive

Introduction

Grid extension is prohibitively expensive in most remote areas in emerging markets and solar home systems can proliferate quickly, but offer very limited service and cannot serve electricity demand as it grows over time. The International Energy Agency has therefore determined that microgrids are the most cost-effective energy access solution in more than half of the world's off-grid areas. Traditional microgrids, however, are usually powered by diesel generators that emit toxic pollutants and are expensive to operate. Most microgrid systems also lack adequate control technology, making them susceptible to energy theft and expensive to operate; collection rates are often as low as 50%.

Before Powerhive, no existing energy access solution offered both the cost-efficiency and level of service required to meaningfully improve quality of life.

Approach

Powerhive, a leading microgrid solution provider, was founded in 2011 to meet the vast unmet need for modern energy in emerging markets.

The Powerhive solution takes advantage of plummeting solar and battery costs, innovative financing mechanisms, and advanced metering and communications technology to solve the energy access challenge. Powerhive's microgrids serve all members of a village, including residential and business customers, with 24/7 access to AC electricity. Customers pre-pay for electricity using existing mobile money systems, and Powerhive uses its proprietary metering and control platform to turn on their circuit when payment is received. When a customer's balance is low, they receive a text message telling them it is time to top-up, and when they reach a zero balance their service is automatically disconnected.

This remotely managed payment system, as well as built-in theft detection and maintenance alerts, drastically reduces the cost of system operation. By providing AC electricity at the community level (as opposed to single-home systems), Powerhive microgrids are appliance compatible and can serve relatively large loads. The end result of Powerhive's innovation is a long-term solution to the energy access problem. Powerhive is able to serve customers continuously as they climb the "energy ladder," from basic at-home lighting to productive, income-generating uses like agricultural processing.



Powerhive customer Peter O. (above) says: "Before we had this electricity I made very little money. Now I have tripled my income using an electric lathe."

By minimizing costs and streamlining project operations, Powerhive's solution is highly replicable and scalable. Powerhive's microgrids provide clean, life-changing electricity that can lift millions of emerging market customers out of poverty.

Achievements

Powerhive has deployed four pilot projects in the western highlands of Kenya to test and improve its proprietary technology and business model. The first pilot project of 1.5 kW was commissioned in August 2012, catering to a small cluster of residential customers who live in the village of Mokomoni and use Powerhive electricity for indoor and outdoor security lighting, mobile phone charging, and small appliances such as radios and televisions. The next three sites, serving approximately 1,500 people, were built in the summer of 2013 in the villages of Nyamondo, Matangamano, and Bara Nne. At 10, 20, and 50 kW, they are capable of supporting larger clusters of users that include light commercial customers such as welders, carpenters, and millers.



A functioning Powerhive microgrid, including solar panels and a central facility that houses batteries and inverters, at the village of Mokomoni in Western Kenya.

The diverse group of customers in Powerhive's four pilot villages ranges from households that use electricity exclusively for lighting and mobile phone charging to small shops, light industrial facilities, schools, and medical centers. Before Powerhive, they used kerosene, diesel, candles, and batteries. Every day for the last few years, pilot customers have been buying electricity, demonstrating that Powerhive service is preferable to these alternatives. Ninety percent of Powerhive users always have a positive credit balance.

Further, as shown by years of pilot data, average per-customer daily electricity usage has steadily increased, proving that customers are increasing their access to energy services and energy-using appliances over time. Access to electricity in Powerhive's pilot villages has generated prosperity and helped entrepreneurial residents achieve their potential. Powerhive customers are now able to light their homes longer to work or to study. They also benefit from increased access to information, entertainment, and connection to the broader world via radio, television, stereo, and satellite dish. Existing businesses have been able to expand, and at least 15 customers have substantially increased their incomes by opening new businesses, which include butcherries, chicken hatcheries, corn mills, and hair salons.

Through a partnership with Equity Bank of Kenya, Powerhive helped its customer's access credit. In addition to seed funding, Powerhive provided business training to entrepreneurs, more than half of whom are women, as they launched new businesses. By carefully tracking commercial customers' electricity use and profitability, Powerhive can identify promising entrepreneurs and offer them a broader range of commercial financial services and other products. In turn, these individuals become steady, high-

load customers for Powerhive electricity. Pilot site operation has proven that electricity usage and economic development drive one another in a virtuous cycle.



(Left) A posho (corn) mill powered by microgrid electricity in a Powerhive pilot village

In recognition of the development impact and commercial suitability of the Powerhive approach, Kenya's Energy Regulatory Commission (ERC) recently granted Powerhive's wholly-owned subsidiary concessions to operate as Kenya's first privately-held utility company. This ERC decision set an important precedent in microgrid regulation that will have far-reaching implications for energy access by allowing Powerhive to generate, distribute, and sell renewable electricity from microgrids to the Kenyan public. As a direct result of the Kenyan concession, Powerhive will significantly scale its off-grid utility service over the next year, constructing a suite of microgrids that will serve 100,000 residential and small business customers. The project's funding will include debt from the Overseas Private Investment Corporation, the U.S. government's development finance institution. The ERC's actions illustrate how regulators can unlock private-sector scalability through policy instruments that level the playing field between centralized and off-grid electrification.

As the Director of Economic Regulation for the Kenyan ERC, Dr. Frederick Nyang, wrote, "The Powerhive permit was granted in recognition of the fact that grid expansion is not always the most economical choice to expand energy access; off-grid alternatives have a role to play [...] Powerhive has demonstrated that its microgrids are capable of operating in compliance with the prescribed standards for residential and commercial electricity service provision."

Powerhive's experience in Kenya has demonstrated a path for microgrid development and regulation in emerging markets. The company's forthcoming large-scale portfolio project there will further demonstrate the scalability and suitability of smart microgrids for areas that are beyond the reach of national grids.

Challenges

Years of field testing and early mistakes have enabled Powerhive to continuously improve its technology and development toolkit. The key barriers to entry have proven to be site identification, retail service, metering, and of course costs. In each of these areas, Powerhive has had to innovate to develop an affordable, turnkey offering.

Site selection, for example, proved challenging with Powerhive's first pilot projects. By definition, microgrids are most suitable in remote, off-grid areas. The cost and challenge of surveying villages can therefore be prohibitive. Finding sites that offer sufficient population density to minimize distribution costs is also crucial, as is finding sites

where individuals can afford the cost of electricity. In response to the challenge of site selection, Powerhive developed a GIS-based tool to remotely identify and select microgrid sites. The tool, called “SWARM,” analyzes satellite imagery to deliver a ranked list of the most financially attractive site options in a given area. After sites are selected, it is crucial to involve community members early and often in order to lease land, sign up customers, and obtain regulatory approvals. Powerhive has developed a process to quickly engage communities, including through community meetings, customer surveys, and collaboration with local village chiefs. Paired with a streamlined customer engagement process, SWARM allows Powerhive to rapidly identify commercially viable microgrid locations.



Powerhive’s Ground Operations Manager Evans Magembe addresses a community meeting at a pilot site.

As discussed previously, retail service has been another major barrier to entry for microgrid providers. The high cost of collecting fees in person is hard to justify in remote locations where per-customer expenditure can be as low as a few dollars per month. To get around this challenge, Powerhive developed customer management software that integrates seamlessly with existing mobile payment systems. The market for such applications is vast: according to the GSMA, telecommunications industry trade and advocacy groups, 411 million people worldwide have access to mobile networks but not to electricity. In order to enable this remote retail service, Powerhive also had to design an integrated meter that could send accurate usage data in real-time to the online grid management platform. Because of challenges at the first small pilot site, including high costs, electricity theft, and inaccurate metering, Powerhive improved its technology. Version 2.0 of Powerhive’s meter slashes costs by metering up to 20 customers from a single point. It has various forms of built-in theft detection. Finally, unlike most meters is it capable of accurately measuring the very low loads that are typical of residential customers in emerging markets. Powerhive’s metering and control platform is uniquely suitable for emerging market off-grid applications.

Powerhive has also gathered millions of data points on energy usage, power production and use, and customer payments. These developments have slashed the cost of new customer connections in half, eliminating a barrier to access and greatly increasing the size of the market that Powerhive can reach. The unprecedented data has enabled Powerhive to select ideal microgrid sites and accurately size systems to meet customer needs. Despite challenges, Powerhive has achieved measurable, sustained impacts in the communities where the company works while gaining unparalleled data and understanding about energy access customers.

Future Plans

Having proven the scalability and development impacts of the model in Kenya, Powerhive is pursuing rapid expansion into new markets. The goal is to deploy Powerhive's microgrid solution to more than 25 million customers in more than 40 markets over the next ten years. The company looks forward to finding more and more innovative ways of complementing centralized grids with off-grid electrification options.

In Kenya, the 100,000-customer portfolio will be followed by additional, similar projects in partnership with different county governments. While expanding throughout Kenya, the company will simultaneously pilot operations in new markets. Powerhive's next new market will likely be the Philippines, where the company has engaged local partners with decades of energy access experience. Powerhive will experiment with Greenfield Development to serve the 29 million Filipinos without electricity access, and will also retrofit existing, expensive diesel microgrids there. Other interesting future markets include India, where an estimated 304 million people live without electricity, Nigeria (93 million), and Rwanda (10 million). Powerhive will maximize its growth to scale in these far-flung locations through partnerships with global utility companies, telecommunications providers, governments, and independent power producers (IPPs).

As Powerhive grows internationally, it will continue to field-test different partnership approaches that increase both scalability and impact. For example, Powerhive will work with micro-finance providers to scale-up the program that helps customers start new businesses. There are also plans to partner with telecommunications companies to pair electricity access with access to Internet services and low-cost electronic devices like smart phones or tablets. The presence of electricity also enables the provision of a suite of critical services for which there is proven market demand, such as clean drinking water, irrigation, telemedicine, and financial services. Powerhive will include these offerings in its microgrids where feasible. Adding ancillary services will increase community development and will also ensure Powerhive's viability by driving electricity demand.

The company looks forward to finding more and more innovative ways of complementing centralized grids with off-grid electrification options as it expands internationally in the coming years.

e. Solar Electric Light Fund (SELF)



Introduction



As the concept of solar household electrification began to take root and germinate around the world, SELF decided to look for innovative ways in which solar energy could be harnessed for uses beyond the home to address a wider spectrum of needs and priorities at the community level.

In the 1990s, the organization focused on using solar energy in homes to power lights, radios, televisions, and small appliances. During this period SELF pioneered the use of microcredit to finance solar home systems, and in 1997, spun off a for-profit business named SELCO (Solar Electric Light Company) that has installed solar systems in more than 130,000 households in the south of India.

Beginning in 2000, SELF embarked on its next generation of projects that would seek to harness solar energy for things such as advancing water pumping and purification, purveying electrification to rural schools and health clinics, providing power to small businesses and micro-enterprises, and facilitating communication access.

The first opportunity to fulfill this expanded vision was found in South Africa, where SELF had been working on a project to install solar home systems in the Valley of a Thousand Hills, a beautiful but impoverished backwater region near Durban, in the province of KwaZulu-Natal. SELF installed a 1.5-kilowatt solar array, which generated enough electricity to power approximately 20 PCs donated by Dell Computers and a small satellite dish that delivered Internet access to Myeka High School. This was the first solar-powered computer lab built in South Africa, affecting a wonderful transformation at Myeka High School, where the pass rate jumped from 30 percent to 70 percent within a year and a half of installation.

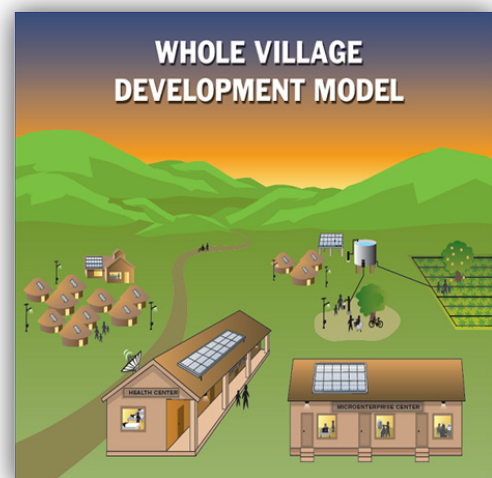
For more than two decades, SELF has been delivering solar power to people living in some of the most remote parts of the world. It has completed projects in more than 20 countries, pioneering unique applications of solar power for—among other things—drip irrigation in Benin, health care in Haiti, telemedicine in the Amazon rainforest, online learning in South Africa, and microenterprise in Nigeria.

Approach

SELF's mission is to design and implement solar energy solutions to assist those living in energy poverty with economic, education, health and agricultural development to help them improve their lives.

Everything SELF has done and learned up to now has culminated in the creation of its "Whole Village Development Model" which takes an integrated approach to community empowerment using a diverse mix of solar energy solutions to improve the lives of people who don't have access to electricity. By working closely with communities and adhering to its operating principles of *SELF Determination*, *SELF Help* and *SELF Reliance*, SELF seeks to ensure benefits in:

- **EDUCATION:** powering lights, computers and internet services.
- **HEALTH:** powering clinic lights, labs, diagnostic equipment, and vaccine refrigerators.
- **WATER & AGRICULTURE:** powering water pumps for clean drinking water and year-round crop irrigation.
- **ENTERPRISE:** powering centers for small businesses and providing electricity for machinery and equipment.
- **COMMUNITY:** electrifying homes, community centers and street lighting.



Through this model, SELF is transforming lives. Many adults for the first time have access to quality health care services, clean drinking water and sustainable sources of food. And the children born into the communities where SELF works can look forward to decent health care, clean water, schooling, nutritious food, and opportunities their parents may have never dreamed about.

Achievements

Over the years, SELF has continued to push for using solar energy for a broader range of development objectives.

> Benin

In Benin, as in many other parts of Africa, solar energy has an enormous, yet largely untapped, potential to increase food security in regions that experience a long dry season.

During the dry season in the district of Kalalé, located in the northern part of Benin, there is precious little rainfall and the



land is parched. Little can be grown, and often its people go hungry.

SELF's work in Benin began in 2006 when it put together a plan to use solar power in the district of Kalalé for a variety of uses in schools and health clinics, and for water pumping systems, street lighting, and providing wireless internet access to the community.

A needs assessment revealed that the primary concern among the local communities was food security, and finding a way to overcome the endemic lack of water that can grow food, a large contributor to the cycle of poverty and poor health in the district.

To solve that problem, SELF developed an innovative way to use solar energy to power a well pump to draw water from an underground aquifer and gravity feed it through a drip irrigation system into gardens. The system became known as a Solar Market Garden™ (SMG).

In 2007, SELF installed three SMGs for women farming collectives in the villages of Dunkassa and Bessassi located in Kalalé. Residents saw the transformative power that this simple and effective technology had on their lives. A significant increase in food security in the villages was seen; each garden supplied nearly two tons of high-value fruits and vegetables per month. And because the communities had access to year-round food, their nutrition improved and the income of the women farmers also increased by an extra \$7.50 per week from the sale of fresh produce at a local market. The extra income has gone towards helping to pay for school fees, medical treatment, and new small business development.

In addition to the SMGs, SELF also installed three solar-powered community water wells to help provide the families in Dunkassa and Bessassi with safe, clean drinking water year-round.

SELF extended its commitment to the people of Kalalé in 2012 and 2013 by installing four new SMGs, solar systems at three schools and a health center in each village of Dunkassa and Bessassi to help power lights in classrooms and, examination rooms as well as to power, computers and other small appliances. The local community also collaborated with SELF to develop and build a solar powered micro-enterprise center. Three buildings, constructed in the shape of a horseshoe, house ten shops, creating a center of economic activity in the villages. The center courtyard, shaded by a solar array that powers the buildings, also creates an inviting space for additional, smaller vendors.

SELF's Whole Village Development Model in Benin was achieved with the installation of four additional SMGs and 34 solar powered street lights in Bessassi and Dunkassa. The lighting has increased activity in the villages, and perhaps more importantly, it has improved public safety, particularly for women in the community, by illuminating areas that once were completely dark.



> Haiti



Haiti continues to be the poorest country in the Western Hemisphere, still suffering from the devastating 7.0 magnitude earthquake of January 2010. Delivering quality health care and providing food and water security to the public are top priorities. Solar energy can help achieve these goals, and SELF has been working with its partners, local communities, and the government of Haiti to improve the well-being of the country.

SELF first teamed with Partners In Health (PIH) in 2006 to demonstrate how incorporating solar energy systems into their operations would enable the organization to improve the delivery of its health care services. SELF completed preliminary assessments at ten of PIH's health facilities there, and planned to implement 10 kW systems at each clinic. In August 2009, in the remote, mountainous central highlands of Haiti, SELF implemented a 10 kW solar system at PIH's Zanmi Lasante clinic located in Boucan Carré.

In the aftermath of the Haitian earthquake in January 2010, SELF and PIH reassessed their original plans and decided to implement larger PV systems averaging 17 kW in size, a 70 percent increase in capacity, at seven health centers to increase the quality and amount of critical medical services needed to help with the nation's recovery.

Support from both the public and private sectors continued to advance SELF's work in Haiti. The Inter-American Development Bank provided more than \$1 million to SELF to provide solar powered street lighting for two transition camps in Port-au-Prince, and to install solar systems at 12 health clinics on the south coast of Haiti. In October 2011, SELF installed 100 street lights in two tent camps providing security to the residents simply by the light shining through the darkness.



Collaborating with NRG Energy, Inc., in 2012 SELF completed its "The Sun Lights the Way: Brightening Boucan Carré" project by installing solar systems for a Solar Market Garden™, a fish farm, and 20 schools to help improve the education of 6,000 students. The project was funded by a commitment made by NRG Energy through the Clinton Global Initiative and a pledge from the Clinton Bush Haiti Fund.

The Solar Market Garden™ (SMG) is helping to increase the production of crops at the Lashto Zanmi Agrikol farm by powering the water pumps for a drip irrigation system, and the solar array at the Lashto Fish Farm is dramatically increasing fish production by powering aerators for six fish tanks.

Most recently, a funding partnership with the Inter-American Development Bank (IDB), United Nations Environment Programme (UNEP), U.S. Agency for International Development (USAID), and the government of Norway has produced a wide range of solar initiatives, many of which were launched in 2014.

SELF set the groundwork for installing a 140 kW solar powered micro-grid to serve 53,000 people in the three communities of Port-à-Piment, Coteaux and Roche-A-Bateau located on Haiti's Southwest Coast. Preparations have also been made to install a solar micro-grid in Haiti's Central Plateau, the 13 kW solar array will power a one-kilometer power line serving 10 businesses in the micro-enterprise center, along with 50-70 homes and small business stalls along the community's central street. The system is funded by IDB and the Kellogg Foundation.

SELF has partnered with One Earth Designs, a manufacturer of an advanced solar cooker, and Haveserve, a community development NGO operating in LeBrun, to distribute lease-to-own solar cookers to women entrepreneurs. With funding from IDB and the Agua Fund, the women are promoting the devices for personal and commercial use.

Following the completion of one of SELF's SMGs with Zanmi Agrikol (ZA) in 2012, SELF and the Kellogg Foundation agreed to install another one-hectare SMG to support agricultural students at ZA's Corporant campus. This particular SMG will be the first of its kind to pump water directly from a river.

In addition, SELF completed another one-hectare SMG, funded by the Clinton Foundation, on the northeast coast of Haiti. The garden is cultivated by a cooperative that has about 30 farmers. This project is innovative in that, for the first time, water is being pumped from a lake and using a high-pressure drip irrigation system, eliminating the need for the construction and use of an expensive reservoir component as part of the water system.

The Government of Norway announced that it is providing support for a three-year project that will create the National Solar Training Center (NSTC) in partnership with Centre de Technologie Moderne d'Haiti (CETEMOH), a leading vocational school in Port-au-Prince. The NSTC will feature two- and three-year degree programs for those with prior electrical knowledge who seek employment in designing, installing and maintaining PV systems. Intended to be Haiti's premier photovoltaic (PV) training facility with fully equipped labs for practical experience in installing all types of PV systems, the center will also offer short-term courses and develop spin-off courses for other vocational schools in Haiti. Project development began in early 2015, with SELF assembling a team of curricula developers and a project coordinator who will work with CETEMOH.

> Colombia

Approximately six million of Colombia's 46 million people live without electricity. In 2011, SELF began to explore ways to power indigenous villages throughout Colombia through projects such as the Colombian Government's Cordon Ambiental y Tradicional de la Sierra Nevada de Santa Marta (CAT), which seeks to provide indigenous communities with basic facilities in health and education using solar power. SELF's initial project, funded by the Bill & Melinda Gates Foundation, was to field test three solar-powered, battery-free vaccine icepack freezers to support immunization efforts in three remote villages – Sabana



Crespo, Nabusimake, and Gunchukwa – located in the Sierra Nevada mountains of northern Colombia. The goal of this pioneering work is to power vaccine refrigerators and freezers with solar energy – but without batteries – as a model that can be used to extend immunization services to other remote parts of Colombia and elsewhere in the developing world.

SELF continues its work in Sabana Crespo, working with members of the Arhuaco tribe to pursue the benefits of using solar electricity to power their school, health clinic, dental equipment, refrigeration in the children’s nutrition center, and an electronic scale and light in the community’s coffee production facility.

In June of 2015, SELF and APROTEC, an expert Colombian renewable energy organization, installed the micro-grid to connect to the village’s coffee warehouse, health clinic, medical staff housing and three children’s recuperation buildings. Savings from not using diesel fuel at the health clinic and coffee facility will be applied to the costs of the micro-grid’s operations and maintenance, provided by local technicians and trained villagers.

In addition, SELF also installed seven solar refrigeration systems in the indigenous villages of Nabusimake, Gunchukwa, Juerwa and Sabana Crespo. This was done through a Bill and Melinda Gates Foundation (BMGF) Grand Challenges Exploration award, coupled with donations through SELF. SELF installed six solar direct drive (SDD) battery-free vaccine refrigerators and one SDD water-pack freezer—the first to be installed anywhere in the world.

The ability to expand SELF’s work into South America is a positive step towards implementing the Whole Village Development Model across the globe. By using solar energy to power health care and education facilities in Sabana Crespo, SELF is providing essential services to a community that has historically avoided the assistance of outsiders. It is SELF’s goal to ensure that the solar systems installed are successful and sustainable over the long-term so that they may be replicated in other villages throughout the region.

Challenges

Those who live in energy poverty are often beyond the reach of a traditional power grid. For the people living in these areas, solar energy-based power systems offer the best solution in meeting their current and future energy needs.

Despite the potential of solar energy in developing countries, certain challenges have limited its growth and implementation:

1. Solar energy systems require a larger up-front investment than other sources of power, which makes them appear expensive to users and those who provide sources of project funding.
2. The performance and lifespan of a solar system is affected by the quality and frequency of attention given to its operations and maintenance. The



sustainability of solar projects can be compromised due to the lack of experience in taking care of the systems by the end-users.



3. Funds set aside for equipment replacement, repair or upgrade are often overlooked, causing timely servicing of a solar system to be delayed, or worse, to not occur at all.
4. Sources of project and organizational funding can vary from year to year.
5. Willingness of national governments to invest in and adopt solar energy strategies. In many countries, there is little if any Government support in terms of duty exemptions, equipment or installation regulations, donor coordination, or any effort in coordinating the implementation of renewable energy projects. This lack of an enabling environment is in many cases holding back the scaling of solar energy solutions.

Strategies for addressing these challenges include:

1. Increased efforts in national capacity building. As SELF is doing in Haiti with the creation of the National Solar Training Center, efforts need to be strengthened to make sure there are enough trained and competent solar practitioners to both support existing projects and expand the use of PV in new projects.
2. Governments need to be assisted in creating a positive enabling environment in terms of regulations (for safety and quality), tariff controls, import policies and overall national strategies for promoting renewable energy. On the Ministerial Level (particularly in health and education), there needs to be standards for determining what level of electrical supply is needed for each type of facility, a commitment of ownership, and a system for coordinating both national internal efforts and that of donors who may be providing renewable energy systems.
3. A comprehensive sustainability plan is essential for each project. Elements that need to be considered include on-site training for all users and maintainers, provisions for advanced technical support, a reliable supply/resupply chain and, most importantly, an up-front commitment from either Government (preferable) or other project funders for the long-term financial support of the project – especially replacing the batteries.



Future Plans

In looking forward, SELF is focusing on several program areas that will allow it to increase both scale and impact.

- Community scale micro-grids.
- Dissemination of the Solar Market Garden model.
- Vaccine cold chain innovation.
- Country level renewable energy capacity building.

Based on its 22 years of work in the field, SELF is in a position to expand its existing projects that have a proven track record and to pursue new opportunities for growth, sustainability, and income. The organization became a leader in using solar energy for rural development by designing and testing new models and scaling or spinning off those that work. As such, SELF is optimistic that by expanding its services, the organization can maintain its global leadership which will enable SELF to take greater strides towards achieving its vision of improving people's lives with the power of the sun.

f. Self-Employed Women's Association, Bharat (SEWA)



Introduction

While level of poverty plays a key role in access to energy sources; usage of particular kind of energy source can perpetuate poverty. According to the International Energy Association, over 400 million people in India (36% of the total population) live without reliable electricity. Over 725 million (70%) rely on biomass cooking fuels like cow dung, wood and farm waste. One out of six household in urban India is in a slum (17.4%) who largely rely on illegal electricity connection.

Energy access is doubly important in the lives and livelihood of women, due to multiple roles played by them. In majority of household, women undertake domestic work, and are primary fuel collector, fuel managers. Additionally, they are also workers and producers who are engaged in income generating activities. Some of the key issues of informal economy women worker, emerging from lack of energy access are highlighted below:

Employment: Regular and remunerative work is necessary for informal economy workers to be able to earn income. Energy plays an important role in quantity and quality of work available to workers. In India, 16 million women home-based workers (incense stick rollers, bidi/cigarette rollers, embroidery workers, papad or snack makers) use their house for income-generating activities. Access to bright and regular supply of lights is crucial to their income earning capacity.

Income: Income is affected by extent of expenditure and savings. Dependence on unreliable and costly source of energy can increase expenditure. For example, kerosene based lighting is more expensive than modern fuels.

Tools of production: Access to assets, tools and equipment based on traditional fuels can determine output and productivity of producer. Using an electric sewing machine instead of a manual sewing machine increases quantity of work but it can be adopted only if there is regular supply of electricity. A study by the Self Employed Women's Association (SEWA) in Ahmedabad city, India, revealed that the productivity of garment workers almost tripled when a foot-pedal was replaced with a machine.



Housing: Construction and design of houses enabling better lighting can conserve energy consumption of household. Delinking electrification from tenure can determine access to grid connection of electricity. House fire especially of houses made of hay increase because of accidents from kerosene.

Health: According to the World Health Organisation, indoor air pollution is responsible for more than 1.5 million deaths in India per year. Health issue can lead to reduced working hours and increased expenditure on medication. Smoke emerging from unclean fuel used in lighting and cooking adversely affects health of workers especially women workers using inefficient stoves.

Nutrition and Childcare: Greater expenditure on fuel leads to cut-down on consumption of nutritious food. Further, children's education is affected due to poor sources of lighting.

It is clear that the need for energy access is severe among informal economy workers and lower income households, particularly for (i) reliable and reasonably priced fuel; (ii) sufficient lighting to carry on productive work at home, at streets and shops; (iii) safe and conducive environment for children to study ;(iv) smokeless fuel for cooking; (v) cost-effective productive tools and equipment.

Approach

SEWA Bharat is a national federation of Self Employed Women's Association (SEWA) organizations. SEWA is a trade union of poor women working in informal economy (such as street vendors, homebased workers, construction workers, agriculture workers and so on). Informal economy workers do not have a fixed employee-employer relationship and depend on their own labor for survival. They are poor, illiterate and vulnerable. But they are extremely economically active, contributing very significantly to the economy and society with their labor. In India, 64% of Gross Domestic Product is accounted for by the self – employed.

SEWA Bharat was established in 1984, with the mission to organize these workers to achieve their goals of full employment and self-reliance. Full employment means work that provides economic security, food security and social security. Self-reliance aims to support women towards being autonomous and self-reliant both economically and in terms of their decision-making ability.

Currently, SEWA Bharat has a membership base of 2 million women workers, across 14 states in India. It works on issue of microfinance, health, livelihood, renewable energy, skill building, and market linkages and so on.

Achievements



In 2010, SEWA Bharat initiated an energy intervention programme in the Munger district of Bihar, India. The objective of the program is to lessen the gap in energy supply and demand among informal economy women workers of SEWA by increased access and adoption of decentralized renewable energy. The focus area of intervention is to address affordability, reliability and awareness. This is undertaken through knowledge building of decentralized energy systems, end-user financing to address high up-front costs, and providing quality after-

Additionally, in 2014, SEWA Bharat took a lead in formation of '**Gender and Energy consortium**', along with Gujarat Mahila Housing SEWA Trust, SEWA Bank, Stree Shakti Vikas

SEWA Trust and SELCO Foundation. The goal of the consortium is to create wider impact and accelerate gender specific intervention from policy-makers, technology developers, practitioners, and academicians.

Since its inception, SEWA Bharat has provided energy services to over 9,000 people. The light system has led to an increase in productive hours, particularly for workers who run small shops; stitch garments; weave clothes; and make bamboo baskets, incense sticks and leaf plates. It is estimated that a home-based worker making leaf plates is able to earn an additional US \$125 in income annually. *Women* workers are the forefront of the model. Energy products are provided in the name of women. Thus assets are created in the name of women. Credit and repayments are done by women lenders. Further, women are the agents of intervention where they lead the marketing and sales. SEWA Bharat is also helping women workers initiate their own microenterprises. This is being done by assessing specific energy needs, matching these with appropriate technology and products, and financing and building skills of the entrepreneur to run the enterprise.

There has been a reduction in household expenditure on fuels by at least 80% in small houses. In slightly bigger houses, solar home light systems have reduced monthly expenditure on fuel by 30%. Households also have the option to charge mobile phones from the light system. This has proved instrumental in reducing the cost of mobile

charging by US \$1.50 (Rs 90) per month, in remote areas, where people had to travel between four to five kilometres every other day to get their cell phones charged.

For its efforts, SEWA Bharat's work on renewable energy was selected as the most innovative work in clean energy in India by Millennium Alliance. Collectively, the Stree Shakti consortium partners have served lower income household through programs on renewable energy, energy efficiency, grid- electricity in informal settlements, energy loan portfolio and innovations for the poor.

Challenges

The primary challenges have been highlighted below:

1. **Technical:** The reach of technology developers are constrained in part by lack of innovative products targeted at low income groups and critical funds for associated product development and research. As a result, the product development is limited either to lighting or at most cooking devices. However, there are several other needs of lower income household that can be addressed by renewable energy, but there is dearth of products. Further, the costly service delivery model to provide after-sales restricts the technology developers to devise effective channels for maintenance of products. Product break-down due to lack of quality services hinders scaling of the intervention. SEWA Bharat therefore has to take this additional responsibility of after-sales.
2. **Managerial:** The role of energy in lives and livelihoods of women has remained unexplored due to limitations in understanding the entire life-cycle needs of women. More focus has been placed on technology and problems of women rather than its end-usage. Women's needs are diverse, in the realm of domestic chores, livelihood, health, entertainment, basic services (water and sanitation), safety and public space (roads, transportation). Further needs can be varied depending on geography, infrastructure, livelihood, social structures and so on. A revised approach needs to be undertaken to address the problem, by viewing women as an integral part of solution. Their participation in intervention has to be sought as end- users, facilitators, service providers, entrepreneurs, and policy makers.
3. **Financial:** Financing of energy products is one of the major road-blocks in promotion of renewable energy. The cost of renewable energy products is yet to become affordable for end-users. Financing from formal institutions like banks are limited due to their hesitance to lend to lower income households. Bankers are unaware of flagship programs of government. As a result, this segment of population has to rely either on their own savings or micro-credit to purchase products.
4. **Government:** There is a need to view energy as part of a cross sectoral approach- where development challenges are viewed together and appropriate government ministries are involved in planning. Currently the programs implemented by various government departments intersecting with energy are not integrated, leading to duplication or gaps in reaching out to those in need.
5. **Cultural:** The education among lower income household regarding renewable energy technology is inadequate. As a result, there is scepticism regarding efficacy of

the products. Lack of information among the target population serves as a constraint. Maintenance of energy systems are hindered by misuse of the products.

Future Plans



Some of the key plans for increasing SEWA Bharat's scale and impact are as follows:

- Skill development of women workers in assembling, manufacturing, marketing, sales and after-sales of renewable energy products.
 - Agriculture support program involving integration of renewable energy to various tools of agriculture practises such as water pumps and threshing machines.
 - Extension of renewable energy programmes to new locations.
 - Design and extension of energy loan products for renewable energy within financial institutions of SEWA such as cooperatives and housing finance companies.
- Integrating renewable energy programmes with organic farming.
 - Piloting new technologies such as refrigeration and mini/micro grids.

g. MicroEnergy International



Introduction

MicroEnergy International's (MEIs) inspiring journey started in Bangladesh; or better said, with a book about Bangladesh - "Banking for the Poor", written by Mohammed Yunus.

During a leadership training carried out in 2001, both Noara Kebir and Daniel Philipp, Founders of MicroEnergy International discovered the tremendous potential of gathering and focusing their resources and common commitment towards renewable energy. "[...] so we decided to start a competition among us-who would have the best idea for a renewable energy research project that could be started together?" After some research and mutual project pitches, their attention was drawn by **Grameen Shakti**, a social enterprise which was disseminating renewable energy systems in rural Bangladesh. As a microfinance subsidiary of the Grameen Bank, Grameen Shakti was offering microloans and had a huge rural network, with an outreach of thousands of people living in structural poverty.

Noara and Daniel decided to design, in collaboration with the *Institute for Energy and Environment* at the Technical University of Berlin and Grameen Shakti, a research project. With the support of special research funding, they started the **MicroEnergy Project in 2002**. Its main objectives were the understanding of energy economics in the rural Bangladesh context, the Grameen Shakti business approach, and the identification of its success factors, together with the development of a replication strategy.

The year 2004 marked the founding of **MicroEnergy International**, an enterprise committed to replicate the Grameen Shakti principals across the Globe.



According to the International Energy Agency, 70% of the world's population currently excluded from electricity services can only be reached by decentralized solutions such as Mini Grids and Solar Home Systems (SHS).

SHS are small-decentralized electricity solutions with a huge impact, particularly for households that have not used electricity before. However, they are not **connectable to the future** because the electricity they provide is limited in terms of peak power by the size of their panel and in terms of usage time by the size of the battery. Only a few devices can be connected to the system and most of them have a consumptive nature and can seldom be used for productive means. People using SHS for a certain period of time profit from the savings on kerosene, which makes them want to 'climb' the energy ladder. But they face serious limitations: if they get access to the grid, they have to re-wire their house with AC wiring and have to purchase new AC devices. If they have no access to the grid and want to grow their system, they often have only the opportunity to buy a new system or to increase their system components.

Accordingly, mini grids are an interesting solution, at least for the electrification of aggregated households and enterprises as it is typical in a village setting. They can provide more power and they can grow. Electricity can be generated with different sources, either with a single or a mix of renewable energy technologies or exclusively or in a hybrid model with fossil fuel generator sets. However, the installation cost of a mini-grid surpasses by far the amount of **capital** available locally and thus, requires the help of external investors. This is not only an impediment to scale, but it is also a barrier for creating local ownership, which is a critical point to assure technical sustainability.



Enabling financing is crucial for a universal access to sustainable and modern energy. A great obstacle that MEI experiences is that the majority of the energy technologies available in the market are designed assuming the weak ability to pay of potential customers; accordingly, the quality is low. This is inherently conflicting with financing through credit mechanisms, as a credit is particularly

difficult to recover from a client whose technology is not functional any more. Not only because it is an unsatisfied customer, also because the cash flows that are typically unlocked through accessing modern energy (e.g. savings on typical expenses for kerosene, dry cells, mobile phone charging etc. or productive uses of energy) are not available anymore to repay installments and interest rates.

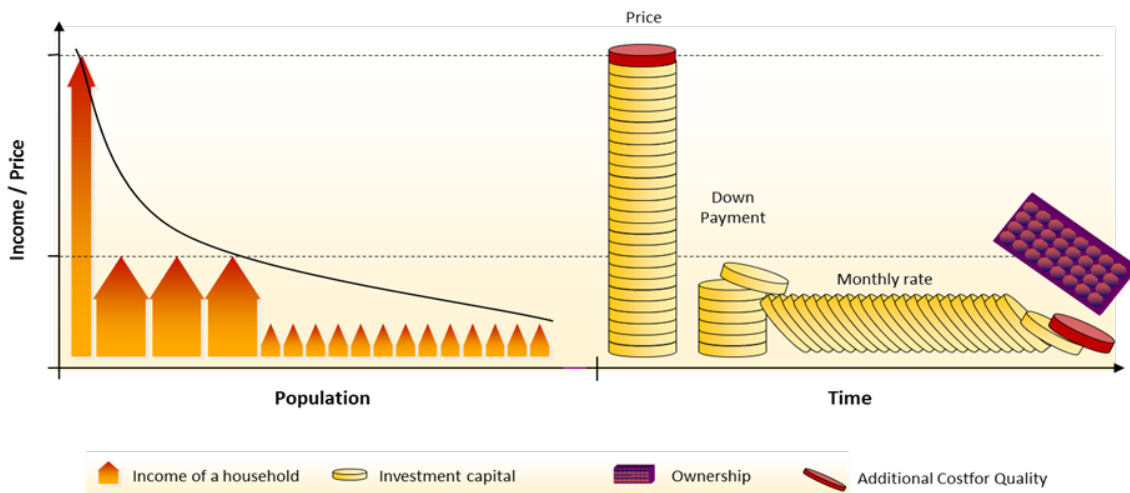


Figure 1 - Financing Modern Energy Technology through Credit

Figure 1 shows how a population with lower income can access modern energy technologies by splitting the total investment into regular installments. Ideally the amount of an installment is as high as the fossil fuel savings. In such a scenario, customers can also afford to pay a higher price to ensure quality and robustness of their product.

Approach

Since 2010, MEI has started to translate lessons learned in this field into R&D activities. MEI has identified the three most relevant requirements for implementing energy technologies in a sustainable way:

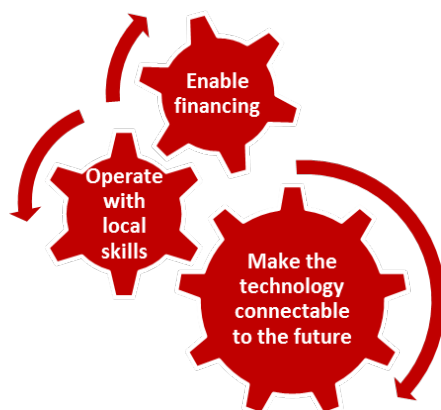


Figure 2- MicroEnergy Smart SOLution Principles

With these principles in mind, one example of a decentralized solution used by MEI is the concept of **SWARM Electrification**:

A SWARM Electrification scenario starts with a new or an existing SHS and a set of highly efficient DC devices. This SHS can be either part of a public or private sector electrification program or purchased individually by an end-user.

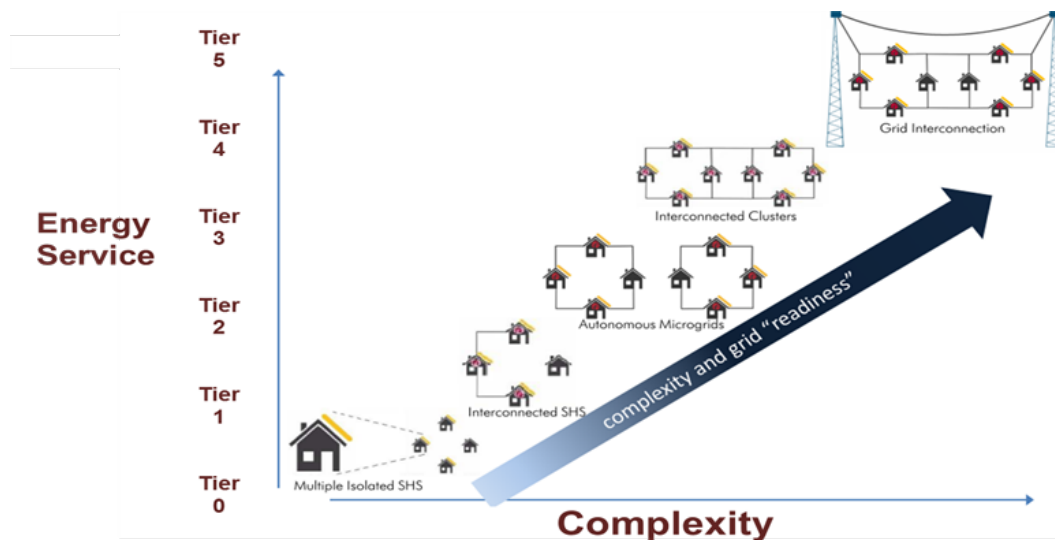


Figure 3 - MicroEnergy SWARM Electrification Concept

Once the end user is equipped with a smart power electronic from MicroEnergy SMART Solutions, the SHS is ready for a SWARM path: If the user wants to have access to more power, he can decide to connect to a neighbor who also has a SHS. Both can now share their power and their battery storage and trade among each other. In the same way further neighbors can be integrated into an autonomous micro-grid and share electricity.

The smart power electronics are designed in a manner that allows the integration and activation of many features, allowing the integration of other power sources, such as small wind or hydro turbines, diesel generators sets and finally the national grid.

In the SWARM Electrification Concept, the power electronics of MicroEnergy Smart Solutions enable also the integration of other features such as mobile payment and remote monitoring. Depending on the business- and operational model, these features can be crucial to ensuring sustainability.

Achievements

MEI translated the lessons learned during their starting years into a holistic and global strategy for **financial and technological inclusion through the involvement of green and social enterprises**.

MEI's contributions to ensure universal access to affordable, reliable and modern energy for all are described below.

The Global Energy Inclusion Initiative

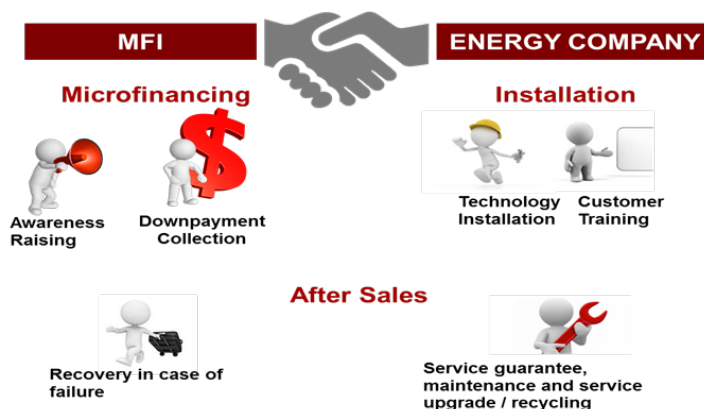


The main objective of the Energy Inclusion Initiative (EII) is to remove financial barriers for sustainable and modern energy products and services with a particular focus on end-user and SME finance. Accordingly, microfinance institutions (MFIs) and inclusive banks are at the center of the initiative. In the last few years, innovative financing mechanisms such as mobile money and crowd funding have been playing an increasing role in activities.

The EII offers a set of tools and instruments with which MEI encourages and enables inclusive financial institutions to offer energy to their current and potential customers, particularly those living in structural poverty. Target groups of these loans might be end users or service providers of energy products or services.

The tools and instruments MEI has developed for the EII take various forms, including capacity building activities, trainings, institutional guidelines, monitoring and evaluation tools, marketing material, match-making and networking opportunities.

In practice, the business and operational models are very different. In some cases, the financial institution offers only the financial services and tightly cooperates with energy suppliers. In other cases, a fully integrated energy product and service is accompanied by a micro credit offer.



The Energy Inclusion Initiative also includes an intensive collaboration with energy product and service suppliers. In many cases, the financial institutions have a much better outreach to structurally deprived areas, and MEI supports the suppliers in building their supply chain in order to reach the last mile.

Figure 4 - Linking financial & energy inclusion



Microfinance clients from MicroEnergy's projects in Peru, Colombia and Ethiopia

Since 2002, MEI has worked with financial institutions and networks in Mexico – Colombia – Peru – Bolivia – Senegal – Mali – Burkina Faso – Ghana – Uganda – Tanzania – Ethiopia – Yemen – Armenia – Pakistan – Uzbekistan – Kirgizstan – Tajikistan – India – Bangladesh – Philippines.

Challenges

- **Technical**

The main technical challenge MEI faces in its projects is finding and qualifying local technology suppliers with the capacity to reach out to microfinance clients and to insure the quality of their products and services.

To overcome these challenges, MEI has developed a tool to evaluate and monitor products and suppliers. MEI regularly updates them and trains partners, particularly financial institutions, in applying them. MEI also uses this tool to support technology partners to improve their products and services to the requirements of financial institutions.

- **Managerial**

Managerial challenges occur particularly where intrinsic motivation is missing. This is one of the main reasons why entrepreneurship stands at the center of MEI's approach. Within projects, MEI focuses on the development of smart incentives along the whole supply chain.

- **Financial**

The Energy Inclusion Initiative is a holistic approach in which MEI has to support very different stakeholders. The biggest challenge for this initiative is to find an appropriate funding mechanism that covers all the project phases. Often MEI has to combine and align different funding sources, which results in managerial challenges. However in Latin America, the EcoMicro Program is making a difference in the field, although it is still missing an appropriate technical assistance mechanism for the energy product suppliers, it is the best funding mechanism MEI has come across for the Energy Inclusion Initiative to date.

Future Plans



Solar Home Systems in Bangladesh

15 years after the inception of the MicroEnergy Project, inspired by the achievements of Grameen Shakti, Bangladesh is today a global champion in renewable energy, not yet in terms of megawatts, but already in regard to the number of households who are receiving their electricity from the sun:

By 2015, more than 3.5 million households have purchased a Solar Home System in the scope of the official national program. This incredible eco system is still MEI's main source of inspiration; this is why, together with its Spin Off Company SOLShare, MEI is now building a grid out of these millions of systems.

Particularly looking at the new Sustainable Development Goals, MEI believes that it not only has to scale up current initiatives into Global Programmes, but also to develop new activities and initiatives.

In the course of MEI's activities in the last 15 years, it has been discovered that despite huge infrastructural inconveniences, many products and services find their ways to very remote areas. Soft drinks, cigarettes, mobile phone vouchers and tiny packaged fast moving consumer goods have developed incredible supply chains to reach out to the most remote places of this world. The development of an approach to systematically green these supply chains by packaging sustainable energy products and services in a way that enables MEI to use these successful supply chains is one of MEI's main upcoming initiatives.

As many colleagues in MEI's sector, MEI agrees that the NEXUS of energy, water and agriculture need to be further developed. Accordingly, MEI is settling a new research group working on the thematic extension of the three main initiatives towards the inclusion of water and agriculture.

Last but not least, MEI is looking forward to find ways and strategies to stronger incorporate the transport sector into initiatives.

h. The Partnership of Village Energy, Centre for Research in Energy and Energy Conservation (CREEC), Strathmore Energy Research Centre (SERC)



Introduction

The Centre for Research in Energy and Energy Conservation (CREEC) is a not-for-profit organization, located at the College of Engineering, Design, Art and Technology within Makerere University in Kampala, Uganda. CREEC's mission is to 'enhance access to modern types of energy through applied research, training and consultancy in East Africa'. The centre focuses on the thematic areas of rural electrification, energy for productive uses, household energy and energy entrepreneurship with energy management as a cross-cutting theme. CREEC's clients and partners include UNIDO and other UN agencies, the Ministry of Energy and Mineral Development and other Government of Uganda institutions, The World Bank, Private Sector Foundation Uganda, GACC, GIZ, Sida, SNV and WWF.



The Strathmore Energy Research Centre (SERC) is an institution that was established with the aim of carrying out high quality research and technical training as well as consultancy services in the energy sector in Kenya. The institution effectively offers services to the government, private sector and the general public.



Village Energy is a for-profit, Ugandan-registered social enterprise co-founded in 2009 with the goal of expanding rural access to clean energy by harnessing the resources of young Ugandans. Village Energy started by assembling and distributing solar systems to off-grid households, small businesses and institutions, selling over 4,000 systems and generating \$240,000 in revenue over 5 years. Some of Village Energy's partners included KCB Bank and the French Embassy in Kampala. However, over time the company realized that the lack of after-sales services for broken solar systems was resulting in communities distrusting solar, creating a bottleneck in the off grid solar market. Thus Village Energy completely changed focus to its new "Community-Based Solar Expert" model in late 2014. Currently, there are 24 employees and 6 franchisees operating a total of 18 retail shops in Eastern Uganda.

Approach

All three institutions realize that sustainability in solar energy is best accomplished through multilateral partnerships between academic institutions, governments, NGOs and the private sector. All the efforts can best be summed up in one of three ways:

1. Research and Testing: SERC and CREEC have become the foremost knowledge centers in East Africa focused on the academic and technical aspects of solar energy.

2. Facilitating Innovation: The Kenya Climate Innovation Centre (KCIC) is the perfect example of how SERC has helped accelerate business innovation focused on climate change and sustainable development.

3. Spreading Economic Benefits: The challenge of creating an entire economy where rural communities directly take part in the economic benefits of the solar industry has been directly tackled by Village Energy, CREEC, and SERC through a focus on developing local expertise in solar technical and entrepreneurship skills.

CREEC is undertaking different activities in multiple areas, including:

- Ensuring universal access to modern types of energy services
- Increasing the rate of improvement in energy efficiency
- Increasing the share of renewable energy in the global energy mix
- Implementing technician training programs in Uganda



Village Energy is seeking to address the following energy access issues:

- Access and affordability of solar products in rural areas
- The lack of aftersales servicing options in rural areas due to lack of local technical expertise and supply chain of spare parts
- Creating employment, entrepreneurship, and other income-generating opportunities for young men and women in rural areas.

Achievements



SERC has partnered with Arizona State University (ASU) and GIZ (a German development company) to set up a training institute in Nairobi to train 100 trainers and through them 1,000 technicians within 24 months (by August 2015). Key to it has been:

- Developing curriculum and standards for 3 levels (T1/T2/T3)
- Deployment of mobile training kits to allow for off-site trainings
- Working with regulators in Kenya to adopt appropriate policies and accreditation standards.
- CREEC has adapted the training for Uganda using off-the-shelf training materials, instead of the custom kits that ASU has provided to SERC for the Kenya trainings.
- Village Energy has partnered with CREEC to train and certify to its technician and shop manager candidates that it has recruited from rural communities.

Other projects include:

Organization	Project Name	Timeframe	Outputs	Lessons learned
SERC (with World Bank)	Kenya Climate Innovation Centre (KCIC)	2012 - Present	\$4.5 mil business accelerator	Model is scalable globally
SERC	Solar Installation			
CREEC	GIZ solar market study	2013 - Present	Analysis of Uganda solar market	Most companies are in market-saturated Kampala
CREEC	Private Sector Foundation-Uganda	2011 - Present	Energy verifications and Audits	Efficiency improvements are effective but awareness is key.
CREEC	Solar/Hydro Installation			
Village Energy	Solar Product Distribution	2012 - 2014	Sale of solar products to rural households	Lack of servicing options undermines trust in solar

SERC:

- SERC's curriculum has been adopted by the Kenyan government as the mandatory standards for training and certification of solar technicians.
- SERC has successfully trained 30 technicians.

CREEC:

- Successfully trained and certified over 60 solar technicians across Uganda.
- Trained tinsmiths to produce, sell and market TopLit UpDraft (TLUD) gasifier cookstoves covering both technical and entrepreneurial skills.

Village Energy:

- Recruitment and training of 40 young men and women in solar technical and entrepreneurship skills.
- Setting up of 6 franchisee shops and 12 company-run retail locations in Eastern Uganda.

Challenges

	Challenges	Solutions
Technical	-	
Managerial	<ul style="list-style-type: none">- Not enough trained staff to undertake all activities fully.- Putting in place professional work culture in rural areas	<ul style="list-style-type: none">- Additional recruitment and trainings
Financial	<ul style="list-style-type: none">- Shortage of funding for training activities- Lack of capital for bulk inventory purchasing	<ul style="list-style-type: none">- More grant funding for trainings- Access to working capital debt funding
Government	<ul style="list-style-type: none">- Bureaucracy and corruption causing delays with approving activities.- Government is slow to move on developing national solar technician standards	<ul style="list-style-type: none">- Working with government agencies to streamline regulations and approval processes
Cultural	<ul style="list-style-type: none">- Lack of consumer knowledge about the risks and opportunities of solar	<ul style="list-style-type: none">- Additional outreach efforts

Future Plans



- To increase the public relations and awareness of CREEC activities to all energy players globally.
- To increase the scale of activities in renewable energy; this will include increasing the scope of testing services, training components and research activities as well.
- With the testing, it is intended to increase the size of equipment to enable the testing of bigger components, and work with the government to certify renewable energy products coming into the country.
- Continue training to expand from stand-alone home systems training to grid tied PV training and so is the same in the other sections of Renewable energy at the centre.



Achieving the aim of a regional model of local technical expertise and a supply chain of high quality products and parts/components will require further collaboration and coordination with various parties:

Academic Institutions: Vocational curriculum training and accreditation, product/component testing and certification.

Private Sector: Product distribution, after-sales servicing, and generating employment Opportunities.

Government: National vocational training and accreditation standards, removing customs/importing barriers.

NGOs and Aid Agencies: Behind-the-scenes advocacy, Public awareness and education campaigns.

Together, the three organizations already enjoy strong support and increasing recognition from a wide variety of international and local institutions, thus together they are confident that the momentum is on their side to achieve the necessary partnerships in the future.

i. SolarAid



"A lot of things have changed [thanks to the solar light]; the house is brighter and the children are happy." Weakness Mwenelupembe in Malawi

Introduction

Globally, 1.2 billion people live without access to basic energy and some 600 million of them live in Africa, beyond the reaches of the electric grid. When the sun sets, the productive day is cut short and they are forced to turn to expensive, dangerous and polluting alternatives to light their homes. Today there are 200 million deadly kerosene lamps in Africa. SolarAid wants to put all of them out of business.

Kerosene lamps are highly dangerous. Most are crudely made from old aerosol cans and a string wick. Families are at constant risk of fires and burns. Children are most at risk of kerosene poisoning, as the fuel is often sold and stored in plastic bottles and easily mistaken for water. Studying by dim light and inhaling toxic fumes from the open flame causes headaches and eye strain, eye irritation and respiratory illnesses.

Kerosene lamps are also harmful to the environment, emitting a tonne of CO₂ and black carbon (soot) equivalent over the course of their lifetime. CO₂ has a long residency in the atmosphere, so reductions in emissions now take years to take effect. Black carbon, however, has a much shorter residency, so reductions now help to mitigate climate change straight away.



The Nobel Prize winning Dr Kirk Smith at the University of California, Berkley, writes: *"There are no magic bullets that will solve all of our greenhouse gas problems, but replacing kerosene lamps is a low-hanging fruit."*

Approach

SolarAid is an international NGO dedicated to combating poverty and climate change by making affordable solar lights available to people living off-grid in rural Africa.

SolarAid was founded in 2006 by the UK's leading solar installation company, Solarcentury, with a donation of 10% of its yearly profits - an annual pledge which continues to this day. The two organisations share a founding Chairman, Dr. Jeremy Leggett, the climate change writer and activist described by the UK broadsheet newspaper the *Observer* as "Britain's most respected green energy boss."

SolarAid started work in East Africa helping schools and clinics with macro-installations and creating some small assembly points for solar products. These projects brought great benefits, but were costly and unsustainable with limited technical knowledge on the ground to help maintain them. Then, around 2009 market forces and technological advancements led to a huge decline in the cost of small, portable solar lights alongside an upswing in their quality. Suddenly, high quality and durable lights that came with warranties and didn't need maintenance - but could light a child's study or a room - were reaching markets in Africa. However, paradoxically, in rural off-grid areas where these products were needed the most, they were not available to buy, and without any experience of solar before, families were locked into a cycle of kerosene dependency.

By 2009 the pan-African scale of the problem was apparent: the real gap in widespread pico-solar adoption was not a lack of technology, or cost, but **last mile distribution**. The same year SolarAid created its African retail brand, the social enterprise SunnyMoney; wholly owned by SolarAid and financed by philanthropic funding and some low-interest, mostly crowd-funded debt. The enterprise is solely focused on achieving its social mission to reach bottom of pyramid customers living at the last mile - precisely those who have the most to gain from investing in their first solar light.

As a result of this change in strategic direction, SolarAid created its BHAG - or Big Hairy Audacious Goal - in 2012 to focus its resources on a single mission: **the eradication of the kerosene lamp from Africa by the end of decade.**

Achievements



Today SunnyMoney is Africa's largest distributor of pico-solar lights, achieving over 1.7 million lights sold to date, lighting up over 10 million African lives in the process. SunnyMoney has catalysed the first two leading African markets for portable solar lights: Kenya and Tanzania, where solar has replaced more than 10% of kerosene usage. SunnyMoney has achieved over 20% market share across the continent, distributing lights in just five East African nations.



The key to success is selling the portable solar lights - not giving them away - through the social enterprise, SunnyMoney. SolarAid believes that when a family buys a light they make an investment, and deserve to exercise their rights as customers - with warranties and customer service. People living off-grid want to invest in a brighter future, but they don't necessarily know about solar lights, how to buy one, or can afford to do so.

SunnyMoney creates supply and demand for affordable, portable solar lights in remote and sparsely populated areas. The enterprise goes where conventionally financed companies struggle to trade, quite simply because they don't take equity. Instead, SunnyMoney is wholly owned by SolarAid and, therefore, the social mission to reach the poorest customers is written into its DNA. The unique hybrid model of charity and enterprise means SunnyMoney can tolerate more risk than other key industry players and sell lights in remote places and in tough terrain.

SunnyMoney's model is so successful because it overcomes the three key household level barriers to widespread portable solar light uptake - lack of awareness, affordability and availability (see *Challenges*).

SunnyMoney works with Ministries of Education to train Head Teachers in the benefits of solar lighting. They then go back to their schools with sample lights to demonstrate the products to the parents of their students who are keen to invest in their children's futures by helping them to study more at night. The Head Teachers then take bulk orders at discount pricing to coincide with seasonal peaks in income - the customer base are mainly subsistence farmers - and deliveries are made during term times. As word spreads, a peer-to-peer endorsement effect is created, and the wider community starts to buy lights, too. Research in Kenya has shown that customers recommend their lights to an average of 20 friends each.

To maintain momentum and meet a newly sparked demand, SunnyMoney sets up a network of agents - independent entrepreneurs, shopkeepers and other local distributors with whom the enterprise can partner with to continue selling outside term time, and provide after-sales care and support. In the longer term, the presence of agents all year round acts as a return point for faulty lights, or those that can be repaired and, in the future, for recycling. 91% of agents SunnyMoney has set up with selling solar lights see an increase in income, on average, by nearly 30%.

SunnyMoney only sells products with the Lighting Africa (a World Bank/ IFC programme) quality assurance mark. As Africa's leading distributor, SunnyMoney's data and experience in the field, and impact measurement, makes a vital contribution to the metrics and intelligence gathered by the off-grid industry.

"Energy is the golden thread in development." UN Secretary General, Ban Ki Moon



Without achieving universal energy access by 2030, attaining other global goals towards health, equality and climate change mitigation is unlikely and SunnyMoney's work directly impacts on 16 of the 17 recently agreed UNGA Global Sustainable Development Goals. SunnyMoney's data, collected through over 30,000 research interactions, tells them that when a family buys a solar light:

- ❖ Families make savings of £134, and recoup the cost of their light within an average of 10 weeks
- ❖ Their children study for at least an extra hour a day
- ❖ The reductions in smoke is the equivalent to not smoking 500 cigarettes
- ❖ Well-being and safety is improved
- ❖ 90% of customers live below the poverty line of \$1.25 per day.

Case study: Lake Zone, Tanzania

The change in energy use for lighting in the Lake Zone Tanzania over the last three years has been dramatic. In 2012, a baseline study by the Dutch development organisation SNV showed that only 3% of households were using solar products. Despite some awareness of solar from foundational programmes in the early 2000s, there was no emerging market for solar energy products. Three years later in 2015, follow up research after programmes by SunnyMoney found that over 50% of households in the six regions of Mwanza, Mara, Shinyanga, Simiyu, Geita and Kagera now use solar lighting products.

SunnyMoney played a major role in catalysing the market in Lake Zone by running School Campaigns - training headteachers to promote lights to the parents of students. Between January 2013 -January 2015, SunnyMoney sold over 270,000 solar lights. This switch from kerosene lamps to solar lights also led to:

- £35,000,000 of savings, 90% of which was by families living below the poverty line
- An extra 340 million hours of study time for children
- Almost 150,000 tonnes of CO₂ being averted, and a reduction of toxic black carbon which provides almost as much equivalent in warming potential and even greater health impacts.

Nearly a million people are experiencing better health, such as a reduction in eye sores, coughing and flu like symptoms and even more have a reduced risk of fire and poisoning. At the same time, savings and increased productive time have led to more spending on food and business inputs that are improving nutrition and well-being.

The Lake Zone follow up survey undertaken by SNV in 2015 noted that a clear demand for solar technologies was now prevalent, highlighting that: *“renewable energy options, particularly solar, are the most preferred technologies among Lake Zone households”*.

Tanzania - Mission Accomplished

In 2015, SolarAid announced that it had achieved mission accomplished in Tanzania. Four years after SunnyMoney started distributing lights in Tanzania, the country is the the most thriving solar market in Africa, representing 12% of Lighting Global sales across the entire continent. SunnyMoney has sold over 900,000 lights on its own, reaching around 15% of the country’s off-grid population and selling lights in every district. SunnyMoney calculates that for every light it sells, another four have been sold by other organisations.

With a pico- solar market successfully catalysed, SunnyMoney has made a tactical retreat from the country, handing over to a private entity to continue trading and meeting demand for solar, ensuring that the philanthropic funding can be channelled into countries and regions across East Africa with lower market penetration, and with the aim of replicating this success across the continent.

Challenges

There remain three key barriers to pico-solar light adoption in rural Africa; the lack of **awareness, affordability** and **availability** of products.

In many remote areas, customers have little or no awareness of solar and its benefits, and this potential distrust is compounded by the upfront cost of an entry level solar light being higher than weekly expenditure on kerosene to which a family is accustomed.

Whereas a basic solar light designed to help a child study at night costs around US \$10 upfront, and the most families recoup the cost within 10 weeks and thereafter pay nothing throughout the 3-5 year lifetime of the light, kerosene expenditure may average less each week, for example around \$2, in perpetuity, and is vulnerable to fluctuations in currency and supply.

Weak infrastructure and limited supply chains exacerbate the problem further. Many companies simply cannot make a profit, so will not sell in tough terrain and to sparsely populated, remote regions. Kenya, for example may be one of Africa's leading markets for solar with increased deployment of venture capital and impact investment, but sales are often concentrated in urban and peri urban regions, with vast swathes of the country left unserved.

At a regional level, barriers to sustainable development for off-grid lighting exist at policy level; with unfavourable VAT (value added tax) and Tariffs key to inhibiting new market entrants. SunnyMoney also works in Malawi, Uganda and Zambia, all have a 1-10% market penetration for solar, with the rest of Africa stagnating at less than 3%. SunnyMoney also sees a threat from "mass dumps" of free products in countries with nascent markets which then undercut local entrepreneurship.

Counterfeit products pose another key challenge, which impacts on SunnyMoney's cashflow and ability to react quickly to fast-paced market dynamics. Once a market is catalysed, counterfeit products quickly appear, on sale for less than the real, reliable, products. These and the people who sell them - sometimes posing as SunnyMoney staff - undermine the consumer confidence that the enterprise has carefully built.

Future Plans



SunnyMoney aims to sell 10 million solar lights by 2020, and scale into 11 new countries, lighting up over 60 million African lives. School Campaigns will scale across new countries to raise awareness and build trust in solar with agent networks following suit. Innovative new models and distribution channels will also be trialled, with partnerships at the forefront of Africa's solar revolution.

"Since the solar light] my lifestyle has changed, my kids eat well, study well and we are a happy family now." Dickson Murumbi in Kenya

SolarAid's key challenge now is to ensure having the working capital to adapt quickly to changing markets and enter new ones. Success in Tanzania came at a price - a decline in revenue and the need to restructure SunnyMoney has strained SolarAid's cashflow. As a result, the enterprise is actively engaging funders and partners to ensure it is poised to launch the next phase of ambitious plans.



In Kenya especially, SunnyMoney is building strategic partnerships to help scale distribution. These fall under two main categories - corporates who are key infrastructure builders in Africa, and partner NGOs and humanitarian organisations.

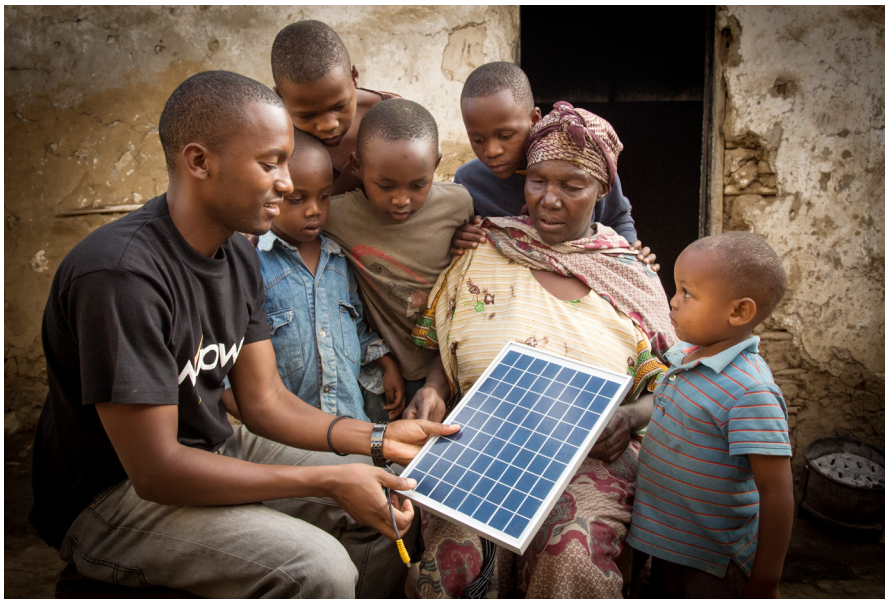
SolarAid has also expanded its work beyond the remit of Africa, and donated lights to the relief effort in Nepal after the devastating effects of 2015's earthquake. SolarAid would like to do more of this work - and reach out to others who want to join in the mission.

j. Masdar

Winner of Special Award 2015



Introduction



1.1 billion people- one in five globally- lack electricity. Masdar, Abu Dhabi's renewable energy company, believes this energy need should be met through the deployment of renewable and clean energy in support of the Global Goal to deliver sustainable energy for all.

Masdar is on a mission to advance the clean energy industry in the United Arab Emirates and around the world, and also plays a leading role as a catalyst for the economic diversification within the country and greater Middle East.

Masdar Special Projects delivers complex renewable energy and clean technology projects in regions that previously lacked secure access to energy. Its clients include governments of developing countries, and foreign aid programmes. Masdar Special Projects is a project management consultancy service, engaged in the development of small and medium scale renewable energy projects (ranging from individual off-grid solar home systems to grid connected centralized plants).

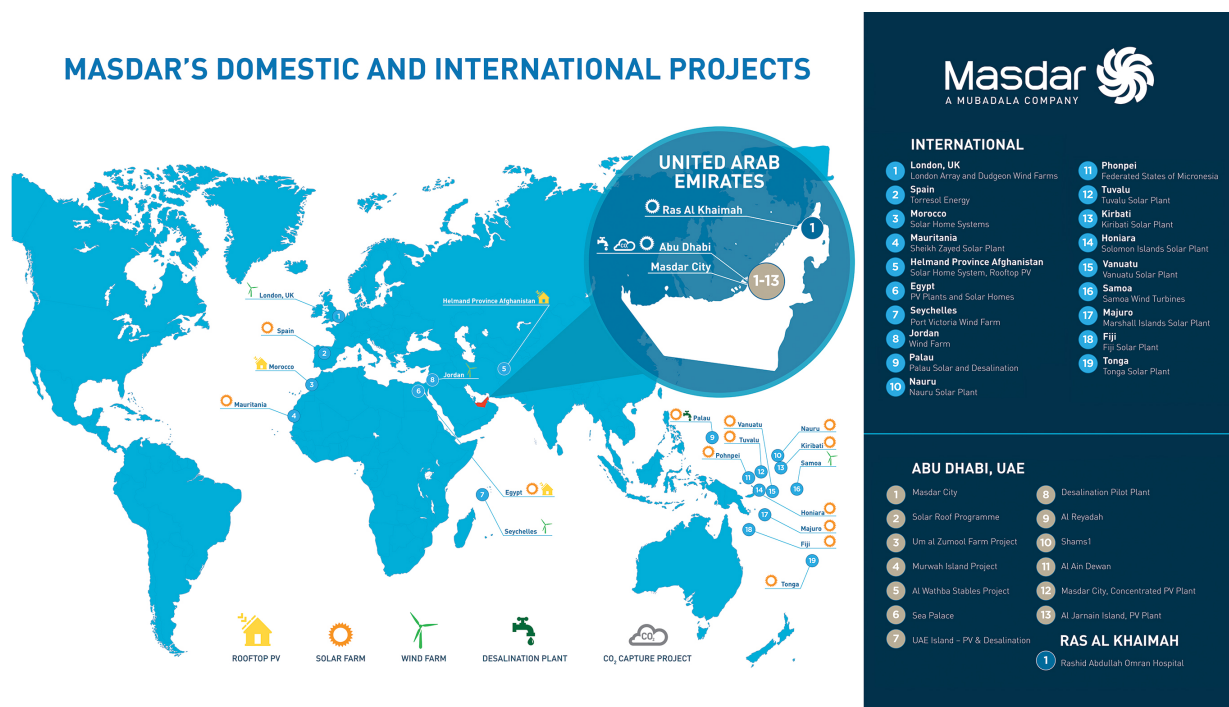
Since its launch, Masdar Special Projects has delivered small and utility-scale renewable energy projects throughout the United Arab Emirates and abroad. Within the UAE, it has launched initiatives involving lighting efficiency, photovoltaic solar installations, wind power farms and an advanced energy efficient desalination program.

Masdar Special Projects has also had significant impact with its energy installations across the world in developing countries. Its mission has resulted in projects that displace carbon emissions, expand energy access to citizens who had no access to the national grid and reduce fossil fuel imports.

Approach

The company has built its reputation by building some of the world's most sophisticated and commercially driven clean energy projects. With a focus on mature technologies in solar and wind power, Masdar is responsible for the generation of nearly 1 gigawatt of clean power, with a goal to increase that amount to 1.5 gigawatts by 2020.

Within its various business units, Masdar offers clients two services: project management in renewable energy and clean technology, as well as sustainability integration services.



The integrated project management division, which works mostly on renewable energy projects, is focused on renewable energy project delivery aided by business and applications development.

On the academic side, Masdar Institute is an independent, graduate-level research university dedicated to advancing renewable energy and sustainable technologies. Established in 2007 in a partnership with the Massachusetts Institute of Technology, the institute integrates theory and practice to incubate a culture of innovation and entrepreneurship. With its international faculty and top-tier students, the institute is committed to finding solutions to the challenges of renewable energy and climate change.

Masdar also manages the Zayed Future Energy Prize, which empowers and rewards pioneering innovators in sustainability and renewable energy. The annual prize plays a key role in providing platforms by which ideas and knowledge exchange can take place

and innovations foster. To date the prize has acknowledged, through its awards, 39 visionaries in sustainability. Of these 39 winners, a significant number are involved with developing solutions to address the energy access issues across the developing world. This ranges from innovative pay-as-you-go solutions in East Africa through to robust and affordable solar lights that illuminate hard-to-reach communities across South East Asia.

Achievements

To date, Masdar Special Projects has completed over 48MWp worth of solar PV and wind power projects across 11 countries and currently has 34 MWp of solar PV projects under development in 9 countries, including several programs in Africa, the Pacific and The Middle East.

Inclusive, sustainable growth is part of Masdar's mission as it expands access to safe and secure energy across the globe. An example of this is a solar home system project in the Helmand Province of southern Afghanistan. The project has enhanced the lives of more than 3,000 people who previously had no access to electricity at all. The installations comprise 545 houses and 55 public facilities such as schools, mosques and clinics. Rooftop solar photovoltaic panels, along with battery storage installations, power basic appliances like refrigerators, fans and lights. Beyond providing electricity, however, the project provides economic opportunity and social equity as Masdar trained users how to operate and maintain these solar systems so that they could function long after they were installed.

Masdar's technical expertise has also proven crucial in countries vulnerable to climate change, including the low-lying islands of the South Pacific. The \$50million Pacific Partnership Fund was established in 2013 to develop wind and solar projects to support economic and social development across 11 Pacific island nations with projects being delivered by Masdar and funding provided by the Abu Dhabi Fund for Development. Several projects have already been delivered or are currently under construction. The first completed project was the 512 kW solar PV installation in Tonga, while others include the first ever 550 kW wind farm for Samoa, and three micro grid solar plants in Fiji that supply clean energy to some of the nation's outer islands, as well as the solar plants for Tuvalu, Kiribati and Vanuatu. Further projects in the Marshal and Solomon Islands, Palau and Nauru are under construction.

Masdar is a strong supporter of the United Nation's goal to broaden access to clean and affordable energy for greater numbers of people.

Masdar recently broke ground in Mauritania on seven solar photovoltaic (PV) projects, with a total capacity of 12 megawatts (MW). The seven power plants will, on average, meet 30% of electricity demand for each of the towns in which they are being developed. The first UAE-funded project Sheikh Zayed 15MW solar energy project in Nouakchott developed by Masdar, was delivered in March 2013. The overall projects of 27MW in Nouakchott, including the seven remote cities, target 50% of Mauritania's population.

Masdar also supports countries that have a goal to diversify their sources of energy. The Republic of the Seychelles currently relies on expensive diesel generators to meet its electricity demand. With fuel accounting for 25 percent of the country's total net

imports, Seychelles is committed to diversifying its energy mix and reducing its reliance on fuel imports. Being an island country, with limited options to produce electricity, wind power generation presents a viable solution to meet a national target of 15 percent energy from renewable sources by 2030.



Masdar Seychelles Wind Power Project

The delivery of the 6-MW Port Victoria Wind Farm by Masdar represented an achievement in engineering. The project required Masdar to construct eight wind turbines, on two separate islands and connect the wind farm with 3 kilometres of subsea cables. In addition, Masdar used advanced turbines that can harness energy during low-to-medium wind speeds and which are resilient to corrosion from the salt and humidity of the ocean.

The role of energy in solving water challenges

As ground water resources are depleted globally, the provision of desalinated water will become increasingly critical. However, the process of creating potable water for sea water has traditionally required high energy consumption.

Masdar has just inaugurated a pilot programme that will see 1,500 m³/day of potable water produced over the next 15 months using four unique technologies that will demonstrate commercially-viable and energy efficient solutions for renewable-powered desalination.

After launching the programme in 2013, Masdar partnered with four global industry leaders - Abengoa, Suez, Sidem (Veolia) and Trevi Systems - to implement the most advanced and innovative technologies in desalination as a key step to achieving water security and reducing energy consumption in the sector.

Masdar also played a key role in launching the Global Clean Water Alliance – H₂O minus Co₂ – on the sidelines of the Paris Climate Change Conference. The Alliance has an initial group of more than 80 signatories and was officially ratified on 26 November 2015. As a founding signatory, Masdar is encouraging governments; energy, water and related industry stakeholders - including laboratories and research organisations; universities and NGOs to join the Alliance.

Challenges

Each project developed by Masdar Special Projects has solved a unique set of challenges, including: bringing safe and clean energy to remote areas; offering skills training to a local population that previously lacked experience with new energy technologies; and developing installations that mitigate risk from extreme weather unique to a particular region.

No two projects are the same, meaning the challenges the teams have encountered have varied widely.

Masdar Special Projects overcomes these challenges by customizing each project to the clients' unique requirements. It begins the process by studying feasibility issues, including the appropriate technology, project roles and responsibilities, special end-user requirements and all types of social and economic impacts.

It then moves into the specific design phase, which addresses issues such as the scope of work, supplier costs, detailed due diligence and budget approval. During this phase, it ensures that the technologies and applications that Masdar selects are commercially sustainable for the clients.

The third phase covers execution, from construction and commissioning to handover. It also provides consulting on setting up operations and maintenance services.

Future Plans

Small grids have historically been unable to achieve significant levels of renewable energy penetration (more than about 30- 40% of peak demand).

Masdar Special Projects intends to replicate and further improve on its recent successes where solar PV penetration rates of up to 70% have been achieved on small hybrid solar /diesel grids. This will be achieved by working in partnership with suppliers and manufacturers of control systems and new generations of low load diesel generators, to stimulate the evolution of technological solutions that can meet the demands of smaller grid networks.

Looking ahead, some of Masdar's clients are now focusing on regional programs which will be deployed in a wide geographical area over a period of a few years. To this end, Masdar Special Projects is interested in collaborating with donors and other project sponsors to explore opportunities for joint project development, to achieve economies of scale and thus maximize the benefits to recipient communities.

k. Electricity Regulatory Authority, Uganda



Nyagak minihydro plant in West-Nile, NW Uganda

Introduction

The Electricity Regulatory Authority (ERA) was established under the Electricity Act 1999, which provided for the formation of the ERA in 2001, with a comprehensive mandate to regulate the now separate generation, transmission, and distribution segments of the sector following the divestiture, which led to the removal of the then monopoly under the vertically integrated Uganda Electricity Board.

The main functions of ERA include, among others, the following:

- i) Issue Permits, Licenses and their respective extensions and amendments
- ii) Establish a Tariffs structure and conduct periodical reviews of tariffs;
- iii) Enforce Licensees Compliance with the Electricity Act and Regulations;
- iv) Develop and Enforce performance standards;
- v) Develop, Approve and Enforce standards to ensure security, quality, reliability and availability of Supply
- vi) Advise the Minister of Energy and Mineral Development (MEMD) on Investment needs in the electricity sector

The current national access to the electricity grid stands at 16 per cent of the entire population in Uganda. The rest of the 84 per cent largely depend on biomass for their livelihood. The three major problems affecting the accelerated increase in access to electricity include the following:

- **Generation Capacity:** Adequacy of generation capacity to meet demand: The current installed capacity is 852MW; the country will however require approximately 17,000MW to ensure that 100% of its population has access to electricity
- **Affordability:** The rural people cannot afford the initial connection cost (approximately US \$100) let alone failure to pay for the monthly bills

- **High initial capital cost for grid extension:** The high initial capital cost needed to extend the grid to rural areas coupled with the low initial load uptake due to the sparse settlements make the rural power extensions not financially viable

Approach



Simba Telecom Ltd./ Building Energy SPA accepts award

The GET FiT programme was established by ERA, the Government of Uganda, and Kreditanstalt für Wiederaufbau (KfW) in 2012 in order to attract private capital investments and increase Uganda's energy production to mitigate possible power supply shortages, before the large hydro plants come online.

This will be achieved by fast-tracking the development of renewable energy generation projects of 1 MW – 20 MW, each promoted by private developers with a total installed capacity of about 170 MW/ 830 GWh per annum. The project provided Premium Payments, which constituted a result-based incentive grant designed to enhance the financial viability of the selected projects. The premium is payable as a top-up premium of US cents 0.5-2.0 per kilowatt hour to the project developers in addition to the respective REFiT tariffs approved by ERA.

The GETFiT program has already facilitated the development of 16 renewable energy projects (Small Hydro, Biomass, Solar Photovoltaic and Bagasse) with a combined generation of 144 MW, and expected commissioning by 2017. According to estimates, the portfolio will reduce emissions by 8 Metric Tons of CO₂, by displacing expensive thermal generation; mitigate power shortages; reduce technical losses; and contribute to the electrification of rural areas.

The GET-FiT program will enable Uganda to exploit clean energy resources, such as solar-photovoltaic (20MW) and biomass (1MW), which were previously not part of Uganda's electricity generation mix due to the high resultant tariffs from high Capex needed to implement the projects.

The programme has currently attracted more than US \$450 million of private capital investment into the Uganda energy sector. The Climate Scope 2014 Survey by Bloomberg ranked Uganda at 10th position out of 55 countries from Latin America, Africa and the Caribbean. In Africa, Uganda held the 3rd position, due to its investment climate for clean energy investments.

Achievements



President Y.K Museveni at commissioning of Kalangala Infrastructure Services Ltd.

Electricity is one of the factors that stimulate economic growth and development. Availability of this electricity to rural Ugandan people will increase productivity (agro-processing), leading to job creation and increased income levels, which will improve the standard of living for these communities.

Access to electricity in rural areas will displace the use of biomass (firewood), currently used for cooking; thus, reducing deforestation.

Women, who spend a lot of their time looking for biomass for cooking, will have more time to care for their families, but also to engage in income-generating activities. Furthermore, there will be reduced exposure to smoke from the biomass stoves and paraffin candles, which will improve the overall health of rural families.

Education centres in rural areas will have access to electricity, be able to operate laboratories, and participate in science subjects. This will lead to improved education services, and increased competitiveness of rural education centres at the national level.

All the hydropower projects are run-of-river projects, whose impact on the ecosystem within the project area is limited. In the case of Uganda, access to electricity will facilitate easy and reliable communication with the rural communities and in return bring public services closer to them.



The 250 MW Bujagali Hydro Project on River Nile

Challenges



Commissioning the Bujagali 250MW Plant in Jinja

The current major challenge for ERA Uganda is to balance the electricity sector's financial sustainability and affordability for rural communities. ERA Uganda has instituted a life-line tariff, which the poor rural population communities benefit from. This means, however that other consumer categories subsidise them. As access to power in rural communities' increases, cross-subsidisation may not continue to be viable.

To overcome this, the Government of Uganda has established other programmes for social economic transformation. One such project implemented is the modernisation of agriculture, under which the Government provides quality seeds, tractors and simple machinery to enable food processing for value addition. The goal is to help increase the communities' income, so that they will cease to fall in the life-line tariff category.

Future Plans

In line with ERA's mandate to advise the Minister MEMD (Ministry of Energy & Mineral Development) on investment needs in the sector, ERA shall continue to monitor the demand - supply balance, and update the national demand forecast and the least cost generation plan in order to optimise resources.

In addition, ERA is establishing mechanisms to incorporate the initial connection cost for rural customers in the tariff to enable them to gradually pay it back, thereby accelerating access to clean energy.



Excavations at the Siti minihydro site in Eastern Uganda

In addition, ERA is supervising the implementation of two additional big hydro power plants, namely Karuma and Isimba, totalling approximately 800MW aiming to further increase generation capacity.

Lastly, ERA is working closely with MEMD to simplify the process of licencing micro-grid projects, aiming to further increase the opportunity of connecting rural communities with electricity at affordable prices.

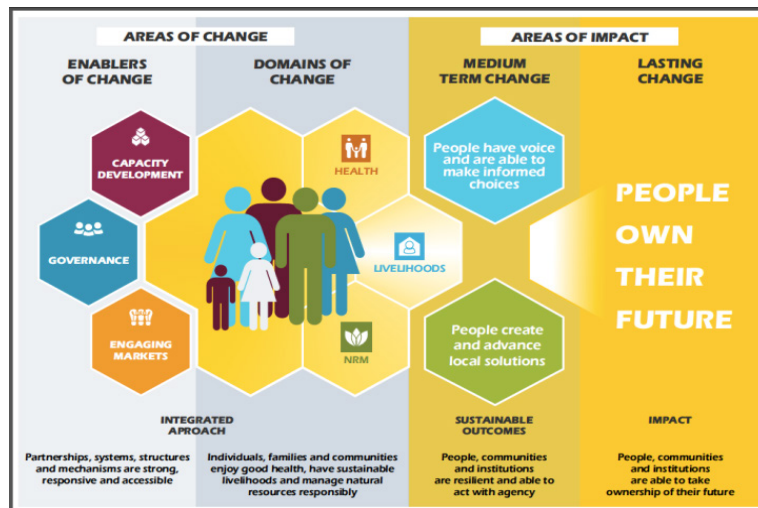
ERA's future goals with partnership potential:

- 1) Development of light handed regulation for the rural based mini-grids
- 2) Development of connection standards for rural low power-consuming customers
- 3) Perfecting the methods for demand forecasting and least cost generation planning
- 4) Capacity building in power system design and simulations for steady state and dynamic stability

1. Pact Institute

Introduction

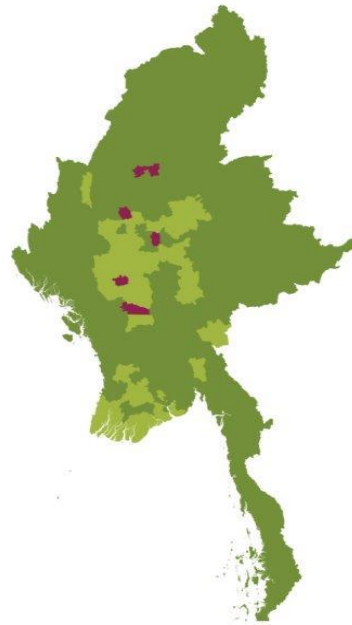
Pact enables integrated, systemic solutions that allow poor and marginalised people to earn a dignified living, be healthy, and take part in the benefits that nature provides. Pact accomplishes this by strengthening local capacity, forging effective governance systems, and transforming markets into a force for development. The people Pact serves are at the center of the organisation’s values. Pact believes that effective stewardship leads to trust and that trust is the foundation for change. Pact’s three core values are: 1) Local Solutions – Success comes from solutions created with the people Pact serves; 2) Partnerships – These deepen impact and promote empowerment; and 3) Results – Pact’s work must transform lives and make them measurably better. How that change occurs is as important as the change itself. Pact’s Vision is a world where those who are poor and marginalised exercise their voice, build their own solutions, and take ownership of their future.



Approach

Myanmar – formerly known as Burma – sits between the two Asian giants China and India. Pact has been active in the country for nearly two decades, and was the first international non-governmental organisation to begin operating in what at the time was a military dictatorship. The organisation began by offering microfinance services, and over the past decade has been implementing a growing integrated community development program. Pact now has an extensive footprint, offering services in some 10,000 villages through the central, south, and now south-eastern parts of the country.

Pact's programmes are oriented toward serving "Ma Mya," an archetype of the women, children, and families whom are served. The foundation on which Pact's work is built is the Village Development Committee, the seat of the community's ownership and management of project interventions, and, ideally, all development activities in the village. Pact supplements this local governance structure with three mechanisms for accessing financial services. The first is a formal micro-finance program, by far the largest in the country, which is operated by a subsidiary institution.



Pact Myanmar's areas of activity

Light green= Pact microfinance services
Purple= Pact integrated community development programme

The second mechanism is a community-owned revolving fund, the Village Development Fund, which Pact Myanmar works with Village Development Committees to establish, manage, and grow over time. Pact matches a community's initial investment of up to \$200. Within a year, interest earned on loans from the fund can produce funds worth multiples of the original contributions, and the value continues to grow over time, with some funds now worth multiple thousands of dollars. A 2014 study of Village Development Funds found that two-thirds remain operative well after Pact programming in the village ends. To date, Pact has assisted 1,400 villages establish and grow their funds to over US \$1.2 million.

The third mechanism is a women's empowerment and savings and loan program Pact calls WORTH, through which groups of women save and invest their funds in income-generating activities. These funds also grow at an exceptional rate, and to date over 50,000 women WORTH entrepreneurs in Myanmar hold \$3.1 million in their funds. Myanmar has one of the least developed energy infrastructures in the Asia-Pacific region: almost 75% of Myanmar's population lives without electricity, which is and continues to be a major inhibitor to development. Geographic location and economic conditions are the main barriers to electricity access for Myanmar's people. This energy poverty greatly constrains development opportunities for tens of millions of poor and marginalised citizens living in rural communities.



Pact Myanmar's integrated development model

Myanmar is one of the least-developed countries in the world, with GDP of US \$854 per capita⁸. The country's electricity supply is highly unpredictable as a result of years of mismanagement and isolation from the international community. Energy poverty in rural areas is even more pronounced than for the country overall: of 65,000 rural villages in the country, only 3,500 villages were connected to the electricity grid in 2012⁹. The national grid is expanding with recent investment, however, and the current government has produced a strategy for the growth of sources of energy.¹⁰

Ironically, decades of isolation and under-development in the country now present Myanmar with an opportunity to leapfrog fossil-fuel-based economic development. As three-quarters of the population currently live without electricity, much of this energy poverty can and should be met directly through renewable sources, rather than having to replace an extensive existing fossil-fuel-based infrastructure – thus avoiding the huge stranded-assets challenge facing most countries.

But this is a limited-time offer. The government has made electrification a top priority. The National Electrification Plan calls for massive investment and scale up of electricity generating infrastructure. The experience with rapid electrification in the region has been largely coal based or large-scale hydro, which have come with increasingly unacceptable environmental and social costs.

The pace of development and foreign investment has been accelerating rapidly since it became clear that the reform process begun in 2011 was likely to continue, and is likely to see a further acceleration following the November national elections, which exceeded nearly everyone's expectations and will advance the reform movement.

⁸ International Monetary Fund (2013), Burma (Myanmar)

⁹ Ministry of Electric Power, Government of the Union of Myanmar (2012), Rural electrification in Myanmar- policies and initiatives (grid and off-grid)

¹⁰ Source: Myanmar Ministry of Electric Power MOEP, 2014

In response to the energy challenge, Pact Myanmar has established the Ahlin Yaung (“light” in Myanmar) program, to provide rural communities with renewable energy via a revolving fund, with the goal of reaching one million people living in Myanmar’s Central Dry Zone by 2020. In its first phase of deployment, Ahlin Yaung is enabling over 100,000 people in rural Myanmar to access clean electricity with off-grid photovoltaic systems. Drawing on Pact’s proven integrated development approach; this program builds village capacity for decision making, longer-term planning, financial management, and management of community resources, while also providing training and education to enable sustainable off-grid electrification.

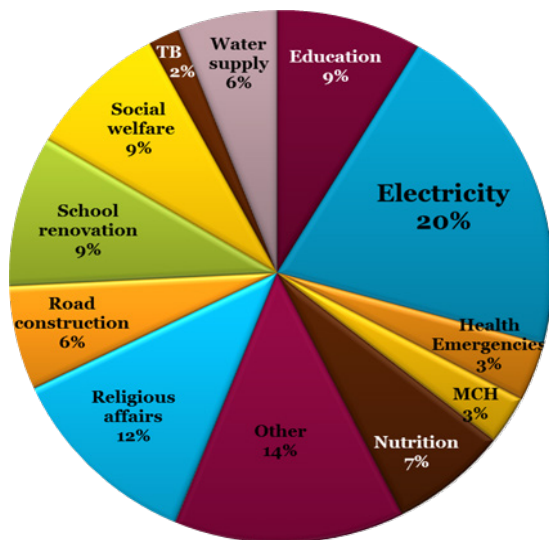
Achievements



A community development "dreams" picture, including electrical infrastructure

When Pact begins working in communities, the entire village is convened to discuss villagers’ development status and needs and what Pact can offer. Pact’s employees ask the villagers to draw pictures of their dreams for development. In addition to schools, clinics, and better roads, they almost all include electrification.

For nearly a decade Pact has worked with villages to establish community-owned revolving Village Development Funds, to help them meet their development goals. When Pact analysed how villages used their funds, which were originally established through a community health program, to ensure that villages had access for funds for health services, it was found that, while 15% of the fund grants and loans went to health-related matters, the single greatest use of funds, 20% or more, consistently goes to electrification. Virtually all of this investment in electrification has been for diesel generators. Village Development Committees use the funds to establish generator-based mini-grids, running wiring to households willing to pay for a connection and a monthly usage fee, typically for a few lights and a charging point for mobile phones, access to which has increased dramatically in the past two years.



Breakdown of VDF usage

This analysis demonstrated tremendous indigenous demand for electrification. Additional assessments specific for the rural renewable energy initiative revealed extensive interest in solar energy generation, as well as willingness to pay for solar-generated electricity. In short, rural Myanmar shows great potential for scaling up renewable energy services.

Pact devised the Ahlin Yaung program and funding mechanism to enable villages to meet their energy needs with renewable systems. Ahlin Yaung builds on Pact’s integrated development model in Myanmar to bring electrification to as many homes as possible

to improve quality of life, focusing on those unlikely to benefit from grid power in the next several years.

Villages are selected based on need for off-grid renewable energy as well as governance and financial management capacity. Village leadership reviews Pact’s list of approved, quality PV products and builds business plans based on community needs and ability to pay, setting the repayment period and interest rates charged to households in a hire-purchase arrangement. The program provides training in operations and maintenance and livelihoods generation opportunities (e.g., mobile phone charging). Interest generated through the loans accrues to the village, to collectively allocate for further community development needs.

Ahlin Yaung comprises two approaches to rural electrification. The first is linked to Village Development Funds. Pact has created an Ahlin Yaung revolving capital fund to provide low-interest financing for 75% of the initial capital for affordable yet quality solar home systems.

To facilitate commitment, the remaining 25% of the purchase price is financed through personal savings or loans from the Village Development Fund. This revolving fund allows villagers to access affordable renewable energy systems via a hire-purchase plan. In addition, Pact provides participating villages small renewable energy grants (up to \$200 per village) for electrifying shared community resources such as rural health clinics, community libraries, community centres, and the like, that benefit the community as a whole. The Ahlin Yaung capital fund current value is sufficient to benefit approximately 125,000 low-income individuals.

Pact works with international suppliers to make quality PV products, information, and training accessible to rural villages. After completing loan repayment, over a six- to nine-month period, households assume ownership of their PV systems, and the replenished revolving fund is then made available to another village. Interest on the capital fund loan is paid into the Village Development Fund, increasing that fund’s capital available for additional community development priorities. Thus, Ahlin Yaung benefits both individual households and the larger community.

Ahlin Yaung offers three levels of solar home systems, all of which have been carefully vetted for quality and affordability:

- **Basic:** 1 bulb (at least 6 hours per day of light), 1 cell phone charging USB port, DC output, minimum two-year warranty; approximately US \$20.
- **Medium:** 3 or 4 bulbs (at least 6 hours per day of light), 2 cell phone charging USB ports, minimum two-year warranty, DC output, can power portable EVD; approximately US \$70.
- **High-End:** 1 lamp and 3 bulbs (at least 6 hours per day of light), 1 cell phone charging USB port, at least one-year warranty for the whole system, including two-year warranty for battery and ten-year warranty for panel, 300W inverter, both DC and AC output, can power AC Television; approximately US \$175.

The second Ahlin Yaung mechanism is linked to Pact's women's economic empowerment program, called "WORTH." WORTH savings groups receive solar charging stations and households receive rechargeable batteries. The WORTH groups establish microenterprises selling low-cost power to the community. Pact is piloting this approach for the financial viability and sustainability of renewable energy services through WORTH entrepreneurs.

Pact's sister microfinance institution provides loans for solar home systems and connects rural clients in Myanmar with quality PV products. To date, Pact has deployed approximately 15,000 PV systems. The program has grown community financial savings, contributed to improved income generation, increased nighttime lighting for children studying and economic activity, reduced costs and health impact from less lighting via candle or kerosene, and increased overall electrification rates.



Training WORTH entrepreneurs to use solar charging equipment

Challenges

A number of challenges face any organisation seeking to introduce solar energy systems in Myanmar. First, given the widespread lack of electrification of any kind, some villagers are uncertain of the potential benefits of electricity or its value. Few have been exposed to the potential of solar until recently. As the pace of reforms in Myanmar has quickened, markets have opened and over the past two years or so inexpensive but low-quality solar has increasingly become available on the local market. Poor experience with these products risks damaging the willingness of villagers to pay higher prices for quality goods, while potentially harming the reputation of solar. Ahlin Yaung products are vetted for quality and come with a guarantee, and Pact thoroughly introduces the program and demonstrates the equipment to villages at the outset.

As part of the government’s plan to expand electrification, government has provided solar home systems free of cost, thus, limiting more-sustainable market-based electrification projects. Substantial competition for the government tenders to supply these systems has driven down the price to a point that providers have trouble making a profit. Pact coordinates with the government and others providing solar solutions to avoid duplication of efforts.

As with many renewable energy systems, up-front costs are a barrier, especially to the low-income population Pact’s program serves. The Ahlin Yaung hire-purchase model and demonstrated village ability to repay loans address this challenge.

Finally, many communities have heard that the national power grid is expanding, and villages that expect to have the option to connect in the near term are typically not interested in what Ahlin Yaung offers. Pact prioritises villages that are not scheduled to receive other renewable systems within the coming year or the national grid within the next several years.

Pact’s Ahlin Yaung program is designed to address each of these challenges. The program’s basis in community structures and mechanisms that have been developed over years ensures community ownership of the process and technology: key elements of success in any development effort. Products offered are carefully vetted for quality and relevance for the specific needs of the communities, to ensure success in using the equipment over time. Pact incorporates training on maintenance and supervision to contribute to sustained results.



Scene from a typical oxen-powered village in central Myanmar

Pact Myanmar’s renewable energy vision goes well beyond household lighting and charging. In the future, Pact envisions turning base-of-the-pyramid communities into customers with buying power, using market forces in combination with the unique community approach to ownership. Pact sees the potential for renewable energy to transform isolated, rural communities. What would transformational change look like? It means enabling oxen-powered subsistence communities to advance their well-being through a fundamentally altered productive



Villagers envision a brighter future

ecosystem. It means enabling Myanmar villagers to power the future they want – through renewable-powered clinics, schools, and enterprises, linked to rapidly developing markets. This will serve as the basis for sustainable development in these long-isolated communities.

Future Plans

Pact's renewable energy vision is to provide sustainable energy access to one million low-income people by 2020. To that end, Pact is actively seeking partners to increase the current scale of Ahlin Yaung. Pact has recently secured a third private sector partner, which will enable expanding the Ahlin Yaung fund in the central Dry Zone as well as to begin operating in a new, underdeveloped region of Myanmar around a Special Economic Zone in the southeast of the country, providing light to an additional 20,000 villagers. Pact continues to seek partnerships and funders to expand in the Dry Zone, as well as into other areas of the country. In the even-more-underserved uplands regions of the country, the peripheral mountainous states, micro-hydro power could be an option.

Ultimately, Pact seeks to move beyond solar household systems and introduce renewable energy mini-grids to villages that are not scheduled to receive access to national grid for several years. Mini-grids can play a meaningful role in spurring economic growth at the rural level. Pact seeks collaboration with organisations to pilot and eventually develop renewable energy mini-grids in high-potential locations to offer an additional level of electrification in rural communities.

IV. Way Forward

The Powering the Future We Want Grant Programme completed a successful first year promoting innovative solutions and recognising leadership and commitment in meeting the global energy challenge. The 12 Grant applicants who reached the top of the evaluation process demonstrated through their initiatives and actions how they are contributing to the United Nations vision of sustainable energy for all.

This vision is a key priority for the United Nations, as it connects economic growth, social equity, a stable climate and a healthy environment. UN-DESA and the China Energy Fund Committee have ensured their commitment to sustainable development by agreeing to implement the Grant programme for an initial period of five years, from 2015 to 2019. As a result, the Grant will continue to be an opportunity to show the world the best examples that demonstrate how science, technology and innovation can be put into practice to induce change and transform the international energy landscape.

Each year, the \$1million Grant will be the beginning of a brighter future for many citizens across the world, as it will help to accelerate implementation of Sustainable Development Goal 7 and support access to affordable, reliable, sustainable and modern energy for all. UN-DESA and the Energy Grant Secretariat look forward to the 2016 Grant cycle and to hearing from many more inspiring international organisations working in the field of energy for sustainable development.

For more information about each finalist please visit the websites provided.

1. We Care Solar: wecaresolar.org
2. BYD (Build Your Dreams) Auto Co. Ltd: byd.com
3. Eco-Fuel Africa: ecofuelafrika.co.ug
4. Powerhive: powerhive.com
5. Solar Electric Light Fund: self.org
6. Self Employed Women's Association (SEWA) Bharat: sewabharat.org
7. MicroEnergy International: microenergy-international.de
8. Village Energy: villageenergyuganda.com
9. Centre for Research in Energy and Energy Conservation (CREEC): creec.or.ug
10. Strathmore Energy Research Centre (SERC): serc.strathmore.edu
11. SolarAid: solar-aid.org
12. Masdar: masdar.ae
13. Electricity Regulatory Authority (ERA) Uganda: era.or.ug
14. Pact: pactworld.org