

Off-Grid-Industry Yearbook

edited by Harald Schützeichel

2016



Off-Grid-Industry Yearbook 2016
edited by Harald Schützeichel

© for this edition: 2016 by Sun-Connect News, Merzhausen (Germany)
© photo frontpage: Stiftung Solarenergie - Solar Energy Foundation
No use of this publication may be made for educational or non-profit purpose or resale or other commercial purpose, without the written permission of the copyright holder(s).

Contact: Sun-Connect News, Weberstrasse 10, 79249 Merzhausen, Germany
email: mail@sun-connect.org
Web: www.Sun-Connect-News.org



Preface

Sun-Connect News publishes since 2012 practice-relevant articles from renowned international authors of the off-grid business. With more than 6,000 recipients of its regular newsletter, Sun-Connect News is one of the largest information media of this young industry.

The most important articles were selected for the present anthology, covering the entire spectrum of the off-grid business. The contributions do not provide a comprehensive handbook, but give suggestions, hints and tips. Some essays are also challenging, stimulate in-depth discussion or opposition. And that's how it should be because the off-grid industry is still young and cutting its own path. To this end, also the controversial discussion of different points of view is important.

Dr. Harald Schützeichel

Content

Introduction

Off-Grid is booming! But which off-grid industry exactly?.....	10
Harald Schützeichel	

Market

How the good old sun and wind will change Africa - and the world - as we know it	14
Christine Mungai	
Why should climate philanthropy care about energy access?	16
Justin Guay	
A bull in a China shop: How SkyPower's plan to donate 2 Million solar home kits in Kenya will wreck the energy access market for decades	18
Daniel Tomlinson	
What you need to know about energy and poverty	20
Sri Mulyani Indrawati	
4 ways in which the solar distribution market differs between East Africa and Central America	22
Morgan Babbs	
Why access to energy is crucial for economic growth and poverty reduction	25
Ian Scoones	
The women can champion use of renewable energy	27
Caroline Kibii	
Reaching the base of the pyramid — and cutting carbon in the process.....	29
Barbara Grady	
Africa's mobile-sun revolution	32
Steven Sinofsky	
Former political activist Thione Niang turns co-founder of Akon Lighting Africa: Reinvention.....	36
Marcia Pledger	

Life

Beyond-the-grid is not just about light, it's about resiliency	40
Vrinda Manglik	
Solar is bringing a new world to women in Zimbabwe	42
John Magrath	
Living a good life beyond the grid.....	44
Karen Fasimpaur	
No grid? No problem! Full power access without the grid.....	46
Harald Schützeichel	
Indoor air pollution may kill 4 million a year	48
Rodrigo de Oliveira Andrade	
Solar irrigation and refrigeration - improving incomes in Zimbabwe	49
John Magrath	
Why solar lanterns can't compete with the grid: Life without light in rural India	51
Jamie Cross	
Solar energy transforming lives in Kenya	53
Lydia Limbe	
Solar energy entrepreneur with keen eye for opportunity	55
Jerry Abuga	
Solar lights a healthy - and empowering - path in disasters.....	57
Marianne Lavelle	

Business

Lessons learned in scaling a social enterprise to solve energy poverty	62
Jennifer Stoneburgh	
The 'Robin Hood' model: A sustainable product testing for developing countries	64
Jeffrey Asher	
Foreign firms don't boost African tech skills	66
SciDev.Net	
Five mistakes that social entrepreneurs make when crafting their brands	68
Anne Miltenburg	
Power surge for women as emerging consumers	70
Tassos Stassopoulos	

A new support for solar entrepreneurs: Senda	73
Harald Schützeichel	
Three solar power projects where women are taking the lead	75
Georgie Johnson	
Off-Grid solar firms should focus on customer experience, not just energy access	77
Daniel Tomlinson	
Africa: the incubator of tomorrow	79
Simone Cipriani	
Lifting the darkness on the price of light -- the effect of fuel subsidies in the off-grid lighting market	81
Evan Mills	
How to meet the solar needs of the rural poor - 3 lessons learned	84
Agnes Cho	
10 things a company needs to know about the market at the base of the pyramid	86
Lina M. Salazar Ortegón	
Africa's new breed of solar energy entrepreneurs	88
Tom Jackson	

Finance

The world's first securitization of Off-Grid solar assets	92
Justin Guay	
Can conservative institutions become the most innovative forces beyond the grid?	94
Daniel Tomlinson	
The underestimated challenge of PAYG (Pay-As-You-Go)	96
Harald Schützeichel	
Getting the big money into social impact	98
Ian Potter	
How crowdfunding might secure energy access	100
Andrew Blyth	
Impact investing needs a better way to measure impact	102
William Burkart	
The rapid rise of impact investing	104
Aunnie Patton	
Big money for energy in Africa must be spent on small producers	107
Aaron Leopold	
Financial innovation and solar power: conquering energy poverty	109
Jacob Winiecki	

Technology

No phone signal in a disaster? Solar network 'in a box' to the rescue	114
Aamir Saeed	
Focus on poverty: Why the grid isn't always the answer	116
Sally Murray	
Is solar-powered LED lighting finally getting a chance to shine?	118
Ed Rodriguez	
Three common mistakes when assessing going off grid (solar and storage)	121
Tosh Szatow	
Solar plus storage becoming "new normal" in rural and remote Australia	123
Jonathan Gifford	
Solar-powered ATMs to deliver clean drinking water in Pakistan	125
Aamir Saeed	
Egyptian method filters seawater in minutes	127
SciDev.Net	
How Rwanda's clinics have gone off-grid and onto renewable energy	128
Taha Selim Ustun	
Water shortage problem solved with solar power? MIT makes salt water drinkable	130
Dana Dovey	
Solar pumps: India's potential to link electricity access and irrigation needs?	132
Varun Mehra	
D-Lab off-grid energy group launches solar lighting product comparison resource.....	135
Nancy Adams	
Grid or no grid, efficiency is key to powering the global South.....	137
Mike Hower	
Honey, I shrunk the grids: The emergence of 'nanogrids'.....	139
Robert Walton	
Trojan Battery introduces "Farm from a Box" off-grid solution	142
Solar Novus Today	

Countries

Pakistan: Light in the darkness	146
Jeremy Higgs	
Half of Australian homes to adopt solar power and move 'off grid' from 2018	148
Jonathan Pearlman	

Content

Next big thing in Bangladesh — solar irrigation pumps.....	149
Anand Upadhyay	
Kenya's Maasai women jump-start Africa's solar revolution	151
Phindiwe Nkosi	
Decentralised energy market in rural Cambodia - A site visit to Kamworks	153
Rahul Shah	
Uncertainty in grid expansion and grid supply: A case study in Bihar, India	155
Patricia Levi and Yael Borofsky	
Lighting up the future in Bangladesh.....	157
Yann Doignon	
Kenya: Solar panels in exchange for tree planting.....	159
Kathryn Werntz	
Lighting up learning - getting connected in Zimbabwe.....	161
John Magrath	
In Pakistan, solar lamps turn women into green energy entrepreneurs.....	163
Aamir Saeed	
Myanmar's path to electrification: the role of distributed energy systems.....	165
Rachel Posner Ross	
Decoding Modi's 'power' play: 'Electrification' doesn't necessarily mean electricity in homes (India)	167
Devanik Saha	
Business mentoring bringing solar to more off-grid customers in Rwanda	169
GVEP International	
A project lights up Ethiopian solar village Arso Amba.....	171
Samson Tsegaye	

Appendix

Authors	174
Sources.....	177
Sun-Connect News: List of publications	183

Harald Schützeichel

Off-Grid is booming! But which off-grid industry exactly?

The global off-grid industry is deeply divided. Over the past years, the regional markets drifted further apart rather than to grow together. The result is a patchwork of five different regions where also very different products and market strategies are implemented:

The media star: East Africa

Currently, East Africa is getting the most attention worldwide. There, essentially three companies are the focus: M-Kopa, Off-Grid Electric and Mobi-sol. The "big three" offer financing to customers, which makes solar systems affordable. They concentrate thereby only on four countries in East Africa: Kenya, Uganda, Rwanda and Tanzania. But in these countries, are also represented all other companies that nowadays offer retail financing, such as SunTransfer, Bboxx or SolarNow. Such strong competition in an area that covers only 19% of the African off-grid population.

But at least: we now finally speak about energy access and no longer just about replacing kerosene lamps. What could possibly become dangerous is that now a market access (customer financing) could be conventionalized into a universal remedy - and moreover the risks could be underestimated.

The economic giant: Bangladesh

Completely independent from the media star and largely ignored, Bangladesh continues to be by far the strongest market for off-grid technology: 65,000 SHS are nowadays sold and installed - per month! But Bangladesh has achieved even more:

the country has also set up a strong manufacturing industry. Whether panels, batteries, LED or charge controllers, Bangladesh's solar companies produce inexpensive and mostly in good quality in their own country.

As before, it remains strange that the lessons learned in Bangladesh about customer finance, distribution or customer service, are hardly seized outside the country. As reason many refer to an alleged exceptionalism of Bangladesh, but this is more an excuse than a justification. It's like people are celebrating in Africa, the discovery of fire, while in Bangladesh people deal with it for many years in a variety of forms.

But also vice versa: none of the producers in Bangladesh has made any significant attempt to expand to other countries in Asia or Africa.

The sleeping giant: India

In the Indian subcontinent, as many people live without power supply as in whole Africa. But the market has its peculiarities: it is protected, the government regulations hinder imports and also slow down the dissemination of off-grid installations due to high bureaucracy. Even investment by foreign companies are rather difficult in India.

This way, operating companies there remain largely among themselves. What is new today, however, is that, compared to previous years, the attention of international media and investors is significantly reduced.

It seems that people have lost interest in the topic Energy Access in India, especially since the

media star East Africa absorbs the international attention.

The newcomer: Australia and Germany

Yet completely unnoticed by the off-grid scene of developing countries, off-grid technology has become an issue even in some industrialized countries. Triggered by the dissemination of LiFePO4 batteries, more and more companies arise, for example in Germany, focusing on the offer of "solar plus storage" - and therefore advertising that households can make themselves completely independent from the grid.

This has now become a large market in Australia: studies forecast that by 2018 half of the local households will have said goodbye to the power grid and will have gone off-grid.

Of course, we are not talking here about "Solar Home Systems". Due to developing countries, the term has the strong image of an "energy for the poor". Instead, we speak of "NanoGrid" and mean the electricity grid within a house, starting from the battery as central storage unit.

The NanoGrid market in industrialized countries has already a size of \$ 1.2 billion, far more than the SHS market in developing countries. Its potential for 2024: \$ 23.1 billion - according to a recent study by Navigant.

The defeated: the rest of the world

These include all African countries that do not belong to the media star East Africa, and this is still around 81% of the African off-grid population! But also the off-grid markets in South America and the countries of Southeast Asia, such as the populous Indonesia.

In these regions, off-grid companies are in fact active, but a powerful market development is out of question. The market coverage is as low as the interest of investors, local banks and governments. The off-grid markets here are still waiting for being perceived and developed.

Developments in the coming years

There are three main developments that are expected in the coming years:

1. NanoGrid and off-grid grow together

There will be a merging of "NanoGrid products" in industrialized countries with traditional solar home systems for developing countries. The big chance: decentralized solar technology could lose the stigma of being a product for the poor. Because to the extent that off-grid products are widespread as well in developed countries, the image of decentralized solar technology will improve also in Africa and Asia

2. Bangladesh' companies expand

It will not be long until the first financially strong solar companies of Bangladesh will expand abroad. And with all their know-how as a manufacturer and distributor. These companies will crucially change the markets in Africa and Asia because they are financially sound, and they can lean on a revenue and earnings strong domestic market.

3. Local SME will be strengthened

Small and medium enterprises (SME) are the main driver for innovation, poverty reduction, employment generation and social integration. The lack of small and medium enterprises (SME) in developing countries is a significant obstacle. Also in the off-grid market a stronger growth of small and medium solar companies, which act independently of international manufacturers, will be needed. Some programs already promote today this development in a very committed way, like GVEP or Sendea (www.sendea.org).

Dr. Harald Schützeichel is founder of the Solar-Federation (www.solar-federation.org) and editor of Sun-Connect News.

Introduction

Market

Christine Mungai

How the good old sun and wind will change Africa - and the world - as we know it

In 1977, the average price of generating energy from sunshine was \$76.67 a watt. Today, the price has dropped to just \$0.60 a watt. It's a stunning 99.2% drop in 38 years, and solar energy is soon going to reach "grid parity" all over the world – the point where it is cheaper, or at least equivalent in price to grid electricity from conventional sources.

Last month's successful flight across the Pacific by Solar Impulse, the world's first fully solar-powered aircraft was a watershed in demonstrating that renewable fuel can indeed do the heavy lifting of modern transportation.

Though the project to fly around the world on the sun's energy has hit a snag – the 7,200km Japan-Hawaii leg overheated the plane's batteries, and aircraft is likely to be grounded until 2016 – it nevertheless demonstrates that a fossil fuel free world is actually possible.

Africa is likely to be a mega player on the green energy scene, with the enormous potential for clean and affordable energy. Sudan's wind alone can power 90% of its electricity needs. East Africa has large geothermal energy potential, while North Africa, South Africa, and the Horn of Africa offer favorable conditions for wind and solar energy.

And with far less invested in conventional generation than other continents, Africa has the potential to leapfrog over old technologies and become a global leader in renewable energy.

Africa attracted more than \$8 billion in renew-

ables investment in 2014, a record for the continent. South Africa accounted for the bulk of that at \$5.5 billion; the biggest deal was the 100-megawatt Xina Solar One project under development by Abengoa Solar at \$1 billion, making it the second-most expensive solar project globally in 2014.

Kenya recently unveiled the \$900 million, 310-megawatt wind farm in Lake Turkana, and a \$109 million loan from German development bank KfW to the Geothermal Development Company for the drilling of 20 wells at the Bogoria-Silali site.

Algeria and Egypt similarly attracted \$428 million and \$226 million of renewable energy investment in 2014.

But even as the business case for renewables in Africa is solid, the politics may prove to be quite another story.

Green energy operates by a very different politics and patronage model than conventional sources – and that might ultimately be the deciding factor in whether it is adopted on a large scale in Africa or not.

Many African countries rely on hydro for their power needs, and a few – including South Africa (coal) and the oil-producers, rely on fossil fuels. Most have a mix of the two, especially as climate change makes water levels in dams unreliable.

A dam is a hulking mass of concrete and steel, but it's often much more than that. Dams – and this could include any mega infrastructure project

– are “temples of the modern nation state”, and “set-pieces of nation building” as this research paper memorably puts it, examining the intersection between big dams and politics in the developing world.

As the embodiment of human ingenuity subjugating nature, they are a symbol that a nation has “arrived” on the global stage.

For instance, Ethiopian officials are fond of showing off the Grand Ethiopian Renaissance Dam, Africa’s biggest hydropower project yet, and a key source of pride is that it has been built without foreign assistance. Computer-generated images of the finished structure are displayed in government offices and city billboards, and broadcast in repeated specials on the state-owned television channel.

As a result, dams are sold on promises – promises of industrial and agricultural revolution, to turn deserts into fields, water into electricity, and ultimately remaking people, from peasants to modern citizens.

It means that the political currency earned by building dam is very high indeed, even surpassing its actual usefulness.

There’s an anecdote told about how officials in newly independent South Sudan resisted the roll-out of mobile coverage in the country, asking, how can people tell that we’ve “brought development” if they don’t see the poles and wires (of landline telephones)? Because you can’t physically see the mobile network, it’s much more difficult to convert it into political mileage.

It’s the same position that renewable energy is likely to find itself in.

The sun and wind is ubiquitous, but paradoxically remote and intangible. You can’t claim ownership; the sun shines on everyone and you can’t touch it, unlike a river that passes through your home village and so you can say it’s “yours”.

With the fall in the price of solar panels and storage batteries, there’s an opportunity for the 600 million households in Africa without electricity to entirely bypass the traditional energy model.

Traditionally, the relationship between a government and its people is one of bartering political support for the provision of certain services, such roads, schools, electricity, water and security.

But today, African life is characterised by an extensive retreat of the state from a range of func-

tions. In Kenya, for example, the number of private primary schools rose nearly 1,000% in just a decade, from in 2001 to 2011, while the number of government primary schools grew just 40%.

In Uganda, the percentage of university students attending private institutions jumped from 9% in 1999 to 74% in 2011. In South Africa, there are more private security guards than police and army combined.

With the possibility of being entirely off-grid, renewables could finalise the disconnection of African everyday life from the happenings in the political sphere.

But even more significantly, it could ultimately signal a shift in the cultural consciousness. Each energy source brings certain cultural values, this article by Barry Lord in Newsweek says, either because of what we have to do to get it, or what it makes us believe about the world.

Coal, that powered the Industrial Revolution in the 18th and 19th centuries, fostered the values of discipline and a strong work ethic, just because of how difficult and dangerous it was to get out of the ground.

But oil and gas don’t require masses of poor miners huddled in the ground. The industry needs very few bodies on the ground, but money that flows is seemingly endless. As a result, if fuelled a consumption, consumerist (and corrupt) culture that has come to define the latter half of the 20th century.

But with the shift to renewables, the message is different – it brings with it a “powerful message of stewardship and an abiding concern with sustainability,” Lord writes.

As renewable energy increasingly replaces fossil fuels, the African values of community and guardianship over nature might yet remake the world as we know it.

Christine Mungai is a Writer/ Journalist/ Researcher with Mail & Guardian Africa.

Justin Guay

Why should climate philanthropy care about energy access?

Investing in clean energy access provides a disruptive opportunity to revolutionize electricity systems and get on the right side of the politics of development -- philanthropy just hasn't realized it yet.

To be fair, philanthropy needs to step up its game on climate across the board. Our investment is woeful -- only 2 percent of all philanthropic funds are devoted to transitioning to a clean energy economy and staving off the worst impacts of climate. That's why some big name foundations are calling on their colleagues to step up giving, and act on climate.

But it's not just the sheer dollars that matter - it's also how we spend them. While we have a lot of work to do to be more strategic one of our most glaring blindspots is energy access. To turn that around someone needs to take the time to make the case that spending scarce climate dollars on energy access will drive transformational change. So let me give it a try.

Clean Energy Access Gets the Politics Right

For the more politically oriented amongst us let's be overt - the politics of climate at the global level are broken and they contaminate everything. We need to proactively seek opportunities to change those politics by aligning development and climate goals in an explicit way. Supporting the entrepreneurs working to bring poor rural communities their first energy services from clean

energy sources like solar home systems and mini-grids aligns renewable energy with development. It means our solutions to climate are also the solutions to poverty alleviation, not the obstacle it's historically been. With exciting new research from the World Bank suggesting that distributed solar is also driving financial inclusion we have the opportunity to invest in an intervention that has cascading development benefits. All of which reframes our issue in a powerful way: the world's most advanced technology -- clean, distributed smart grids -- are the most appropriate for the world's poor. India's Prime Minister Narendra Modi understands this, that's why he promised solar, not coal, for all by 2019.

Clean Energy Access Is Disruptive

In the 21st century where mobile phones are ubiquitous no rural villager demands, or expects, land line telephones. What's more, those villagers will increasingly demand access to more sophisticated communications services like the internet via their mobile devices. But they struggle to keep their phones charged thanks to a lack of power which is causing Telecom companies and their counterparts in the tech industry from Silicon Valley, giants like Facebook and Google, to lead the drive to electrify the poor. That constituency realizes the only way to quickly and cheaply power those devices is not to wait for the centralized dumb grid -- it's to quickly and nimbly deploy smart

distributed generation. More importantly, the companies leading this charge are doing it with a potent mixture of mobile money financed distributed clean energy solutions, super efficiency, and innovative pay-as-you-go business models that deliver energy as a service. Ultimately, that creates a clean distributed smart grid that serves the poor first, not last. Meanwhile the rest of us deal with our 19th century dumb grids and their entrenched dinosaurs who fend off the future by trying to tax the sun while they fight for the right to continue to pollute our air and water.

Clean Energy Access is Mitigation

You'll notice that the direct mitigation piece of this puzzle comes last. That's because the politics and disruptive potential of these interventions are the real selling point. But that's not to say there aren't tons of CO₂ to be mitigated. Far from it. Take India where 75 GW of Diesel gen sets are installed which form the 'distributed reliability backbone' to the notoriously unreliable grid. That total is equivalent to half the country's coal fleet which is being added to at an incredible clip of 17 GW this year alone. A consumption whose giant sucking sound evaporates the country's foreign reserves and decimates the rupee's value.

But while diesel replacement is big, the far

more interesting opportunity lies in the super efficient appliances necessary to wring services out of pico solar and their rebound effect for the developed world. No, not that rebound effect -- I'm talking about a positive effect that makes super efficient TVs (7 watts in off grid settings) the norm across the globe thanks to the sheer purchasing power that 1.2 billion consumers wield. Just imagine the US congress trying to justify appliance standards that are weaker than those in Bangladesh and you get the sense of the disruptive impact super efficiency could have on global appliance markets.

All said and done there is quite a case to be made for clean energy access. But outside the admirable efforts of the Rockefeller Foundation or the newly announced super efficient appliances work supported by Climate Works this issue still largely remains under the radar. It's high time we seized this opportunity and asserted a vision of the future that puts the needs of the poor first - by building a clean energy future from the bottom up.

Justin Guay is a program officer at the Packard Foundation working on energy and climate issues.

Daniel Tomlinson

A bull in a China shop: How SkyPower's plan to donate 2 Million solar home kits in Kenya will wreck the energy access market for decades

The road to hell is paved with good intentions, and that's exactly what is afoot with SkyPower, a utility-scale photovoltaic energy company and their plan to donate two million home solar kits to "the people of Kenya".

There are appropriate times to donate solar, such as disaster relief, or to schools and clinics who otherwise could never purchase them. However, bulk donation programs wreck the market and the customer's perception of solar as a concept.

Solar products need to be deployed and serviced with the highest quality of customer satisfaction in mind. Mainstream bulk donation programs often do not budget for high quality products or invest in the distribution and after-sales service required for solar, leaving customers with either inferior products or, over time, faulty products that stop working and spoil the market concept of solar in general.

In their recent June 2015 Opinion Brief, the Global Off-Grid Lighting Association highlights the issue: "Systematic reductions on retail prices, and especially free give-aways, signal to consumers that they do not need to pay full retail price -- or pay at all -- for these goods, and consumers will accordingly hold out for reduced-cost or free goods in the future, regardless of whether they will ever come. While there may be a short term benefit for selected users, these reductions or give-aways will

result in such adoption being less likely to be sustained and broader adoption of solar off-grid lighting being significantly hampered."

The tainted history of donating solar products to households is long and well-known by the industry, which makes SkyPower's initiative puzzling and to some down-right upsetting. From political campaigns, charities and corporate CSR, donating solar products to households has been done decades over with similar results - A flashy article and photo op for the organization, smiling faces of recipients, and the feel-good effect of thinking something good has been accomplished. It's understandable to want to help when heart strings are pulled at the sight of energy poverty. However the reality of donating solar to the masses is a dark one because of the long term down side such "dump and run" efforts produce.

Distributed energy solutions such as solar home kits are the cheapest, fastest and safest solution to take a family out of poverty overnight, if deployed using market principles of quality and service. They support increased income-generating hours, better and longer home and study conditions for women and children, and overall upward mobility. Ironically, donating solar to a family seems like a worthy endeavor, but without the right infrastructure and investments to support it typically leaves families with very poor experiences which is arguably

worse than doing nothing at all. Losing new energy customer by giving free, inferior products and / or poor infrastructure to support them results in a U-turn in energy access development, not to mention it distorts the market conditions and disrupts the growth of record investments being deployed into the industry.

US President Barack Obama's Power Africa concurs and backs a strong market-based environment for energy access to thrive: "Power Africa supports bringing increased electricity access to Kenya through a market-based approach. Kenya is the center of innovation in off-grid solar and is the home to trusted companies -- many of which are Power Africa partners-- who offer high-quality products with strong warranties and service guarantees."

SkyPower has big, bold plans for Africa and beyond and there's no doubt we need SkyPower's valuable contribution to deploy clean energy for the world. With a revised plan, many beyond-the-grid companies and organizations might like to partner with SkyPower to support their objectives for energy access, however, alternatives in the case of solar kit donations into Kenya would have to be considered. Several attempts were made for on-record comments from Kerry Adler, SkyPower's CEO for this article to better understand SkyPower's plans and discuss constructive alternatives, however, Mr. Adler did not show up for schedules calls. In light of the missed opportunity, SkyPower and Mr. Adler may consider the following:

SolarCity's GivePower program offers a best-in-class example for when it's appropriate to donate IFC Lighting approved solar systems, such as to schools and health clinics backed with on the ground service operators.

Alternatively, natural disaster relief programs such as the deployment into Nepal this past spring demonstrate an effective use of the donation platform with certified quality products.

On the commercial side, SkyPower might consider setting up a working capital fund using the budget allocated to procure product for donation, and instead support beyond-the-grid companies already working in Kenya through deployment of working capital to fuel their efforts.

IFC Lighting Global echoes these recommendations: "Lighting Africa welcomes the participation of companies in the off-grid energy space. Free products can assist people that may not otherwise purchase a solar product, but, if not managed well, they can harm the entire supply chain and the market. Given that consumers spend between \$90 - \$120 per year on kerosene for lighting, Lighting Africa believes that making solar products more affordable will have the greatest impact on accelerating energy access. We recommend setting up financing facilities with local banks and MFIs to support further sales of solar products with a focus on sustainable positive impact."

As a veteran energy access entrepreneur I have seen first-hand the market destruction of bulk donation programs. I have no doubt SkyPower has good intentions behind their plans, yet the Canadian company may wish to think twice before letting loose a wayward bull in Kenya's fast growing energy access market that could wreck the market for decades to come.

Daniel Tomlinson is an access-to-energy entrepreneur and 2012 Echoing Green Fellow.

Sri Mulyani Indrawati

What you need to know about energy and poverty

First, we need to address “energy poverty” if we want to end poverty.

We find that energy poverty means two things: Poor people are the least likely to have access to power. And they are more likely to remain poor if they stay unconnected. Around one in seven, or 1.1 billion people, don’t have access to electricity, and almost 3 billion still cook with polluting fuels like kerosene, wood, charcoal, and dung.

In Africa, the electricity challenge remains daunting. In Liberia, for example, just 2% of the population has regular access to electricity. Even countries with access often have highly unreliable service. One in three developing countries experiences at least 20 hours of power outages a month.

When power is available, it can be expensive: In many countries in Sub-Saharan Africa, consumers pay as much as 20-50 cents per kilowatt-hour against a global average close to 10 cents.

Inclusive economic growth is the single most effective means of reducing poverty and boosting prosperity. Yet most economic activity is impossible without adequate, reliable and competitively priced modern energy.

This is why access to energy is so important in the fight against poverty.

Second, providing energy access needs to be done sustainably.

According to the latest data, more poor people are gaining access to electricity at a faster rate

than ever before. But the share of renewable energy is not growing at the same speed. And we are lagging behind in improving energy efficiency.

The International Energy Association says that in high-income countries, energy efficiency is now the largest source of energy. Because energy saved is energy that can be used elsewhere. This means we can cut the link between economic growth and energy demand just by improving energy efficiency.

China is the giant in reducing energy intensity, saving as much energy as it consumed between 1990 and 2010. But China’s economy is still about twice as energy intensive as Japan’s, leaving much room for improvement.

If we applied all the energy efficiency technologies that are already available today, we could cut energy consumption by about a third. We now see countries shifting from fossil fuels to renewable forms of energy with massive new investment in well-known types of renewables, like hydropower, geothermal, solar, and wind.

Between 2010 and 2012, the uptake of modern renewable energies grew by 4% globally. East Asia led the world in this regard, representing 42% of new renewable energy generation.

Still, the developing world has barely scratched the surface. For example, across Africa and Asia only 10-20% of hydropower potential has been harnessed, and solar potential is only just beginning to be fully understood.

Third, the obstacles to energy access are not just finances. We also need to address political issues.

Many countries continue to subsidize fossil fuels as a way of reducing costs for consumers. But untargeted subsidies are very costly, undermine energy conservation efforts, and mostly benefit the wealthy who use more fuel than the poor. In 2013, nearly \$550 billion of public money was spent worldwide on these direct fossil fuel subsidies. This is money that could be shifted towards development priorities.

Another key challenge for many countries is that renewables are capital intensive and this capital can be difficult to raise in risky environments. Many countries have adopted policy incentives to overcome these barriers. Brazil and India are having success with renewable energy auctions.

Small-scale solar power can dramatically accelerate energy access. Low-cost solar home systems have helped countries like Bangladesh and Mongolia to bring energy to low-income households who would otherwise be living in the dark.

Bangladesh now has the largest national off-grid electrification program in the world. Starting in 2003, with connections for around 11,000 households, the program is now connecting over 850,000 households to safe solar power every year.

The big technological breakthroughs are coming now in the form of energy storage. New battery storage technology could see the world moving much more rapidly to at least 50% renewable energy – or even greater.

Fourth, the World Bank Group is taking the issue of sustainable energy for all very seriously.

We know that getting there will entail tripling historic capital flows to access and clean energy projects. Last year, two-thirds of our lending went to countries in South Asia and Sub-Saharan Africa where the majority of people without energy access live. Over 90% of our power generation lending goes to clean forms of energy: natural gas, hydropower, solar, wind, and geothermal. We do not lend for new coal power generation except in very rare circumstances.

We also play an important role in working with countries to ensure a strong enabling environment is in place that encourages greater investment – especially in renewable forms of energy.

We strongly believe that ending energy poverty is a goal that deserves our full attention. That's why we co-chair the Sustainable Energy for All initiative with the UN Secretary-General. Jointly we focus on three goals: ensuring universal access to modern energy services; doubling the share of renewable energy in the global energy mix; and doubling the rate of improvement in energy efficiency.

We are hopeful that among the new sustainable development goals that the global community will agree on this year energy poverty will be one of them.

Sri Mulyani Indrawati is Managing Director and Chief Operating Officer at World Bank.

Morgan Babbs

4 ways in which the solar distribution market differs between East Africa and Central America

To date, the majority of energy poverty alleviation and solar distribution efforts have been focused in Africa—primarily East Africa. 2.5 billion people around the world lack access to reliable electricity (WEO 2012). The majority of these people reside in the African continent, where the rural electrification rate is only 24% (WEO 2012). With high population density and an extremely high instance of off-grid households, it makes perfect sense that the off-grid solar market got its start in East Africa around 10 years ago. Non-profit SolarAid, which distributes through its social enterprise SunnyMoney, has sold almost 1.8 million solar lights in Africa since its founding in 2006 (SolarAid). Greenlight Planet and d.light, founded in 2007 and 2006, respectively, industry leaders in the product design space, have also maintained a strong distribution focus in East Africa.

Colibrí currently focuses on Nicaragua, where 60% of rural dwellers do not have access to electricity (WEO 2012). This may seem like T-ball when compared to the major-league statistics of East Africa. Sheer market size is larger in Africa; the statistics may show that there is more need, but energy poverty statistics aren't necessarily reflective of the full potential in each market. This post aims to educate on the differences between the Central American and East African markets with respect to solar distribution and to showcase some of the unique challenges each market presents.

#1: Kerosene is not the driving factor behind "Why Solar?" for Central America

Visit the homepage of any solar distribution focused enterprise in East Africa and the language centers around "eliminating the kerosene lamp". Kerosene is extremely harmful to health and the environment and it barely provides visibility. According to SolarAid, kerosene is the most common resource used by those living in energy poverty in East Africa. In Central America, this is largely not the case.

Central American households living in energy poverty primarily use battery-operated flashlights, with the next most common resources being candles and kerosene lamps. In a survey of 72 off-grid Nicaraguan households administered by Colibrí, only 27% of the households used kerosene for lighting.

Sure, candles and flashlights might be the lesser of the evils, but kerosene, candles, and flashlights alike barely provide visibility, are not the most environmentally friendly option, and are all regular costs for the household. Candles may cost 10 cents each, but they must be purchased repeatedly and in large quantities—candles, however, do have the same fire and burn risks as kerosene. Batteries for flashlights have to be replaced every 2-4 weeks. Whether a household is using kerosene, candles, or flashlights, the transition to solar is an extremely important step on the energy ladder.

#2: Higher Price Points Are More Accessible In Central America (generally)

Based on many conversations with some of Colibrí's counterparts in East Africa, including our supplier, Greenlight Planet, there is a difference in products accessible between both markets. The "lowest level" solar product Colibrí sells is a dual solar light and cell phone charger. There is essentially no demand for a single solar light without cell phone charging capabilities in the Central American market, whereas the SunKing Eco and the d.light S2 (both small solar light products) have been some of the best-selling products on the East African market. Perhaps this is due to higher average income levels among the Central American BoP—or simply a preference to invest money in larger, higher capacity solar technology. In fact, in the past two months, Colibrí's most popular product among the BoP has been a solar home system with three lights and two cell phone chargers.

#3: Energy Poverty is Not As Extreme in Central America

As pointed out by the statistics, Central America has a much higher electrification rate than East Africa does. Many of Colibrí customers are indeed connected to the electricity grid. However, electrification is not synonymous with quality electricity service. Service can go out several times per week, often for 6 hours at a time. Blackouts are longer and even more frequent in harder-to-reach areas. It is also common for households in Nicaragua to connect illegally to the grid, making the service more unreliable for everyone in the area involved.

What does this mean? These households are absolutely potential clients. The "sell" is just different than it would be for someone living in energy poverty using kerosene, which is what the average client in East Africa looks like. For an interested on-grid customer, Colibrí often starts sales pitches by asking customers how often they experience power outages and how much they're paying for service. Colibrí's target market is often spending between \$2 and \$8 per month for flawed electricity service—it makes sense that this market would instead want to rent to own a full service solar home system. Solar is desirable as an alternative because it's cost-effective, more reliable, and often more flexible for the households' needs—it's an aspirational product because the prospect of own-

ership is highly valued at the BoP. The potential for solar isn't the number of people living in energy poverty; it's the number of people who want solar or would benefit from solar (and the Earth always benefits from solar).

#4: Financing is Always a Challenge, but Mobile Money Opens Doors in East African Market

I am certainly envious of enterprises operating in East Africa who reap the benefits of (one of the) fantastic mobile money system, M-Pesa. There is currently no mobile money system widely used in any Central American country. The prevalence of mobile money in East Africa provides benefits for the distribution or sale of any good. The Central American BoP conducts almost entirely cash-based transactions. Distribution, customer interactions, and payment habits may differ widely between the two regions due to the prevalence of mobile-based transaction in East Africa. M-Kopa and Off Grid: Electric are two enterprises, for example, operating in East Africa that have fantastic business models with M-Pesa as a key operational feature. Customers send in their payments for their solar home system over the cellular network, meaning M-Kopa and Off Grid Electric staff do not have to go collecting cash payments from thousands of households around the region. The lack of a mobile money service in Central America means enterprises doing pay-as-you-go solar have to get creative with payments so they do not face high operational costs associated with payment collecting and monitoring.

Base of the pyramid electrification efforts in developing markets are often simplified down to a single statistic: the percent of people who "have electric light." The question we care about isn't do you have light, but would solar power be an improvement? It's compelling to point to the 2.5 billion people living in energy poverty, because it is such a large percent of the world population, but those people are spread between continents, languages, cultures and countries. They have different behaviors and desires.

Both markets hold potential for different reasons. Characteristics of the Central American market show high potential for uptake among the non-electrified, under-electrified, and electrified BoP

consumers. Solar technology holds an extremely strong appeal among Nicaraguans. If Colibrí only went about business based on the statistics of those living in energy poverty, we wouldn't be doing justice to the true potential in the market. We would just be serving the "need" segment, rather than addressing the full demand on the market and simultaneously creating new demand. Under electrified and electrified BoP consumers

alike elect solar because it makes financial sense and is often a more reliable, productive, and appealing choice.

Morgan Babbs is Founder & CEO at Colibrí.

Ian Scoones

Why access to energy is crucial for economic growth and poverty reduction

Last week I was in Nairobi for a conference focused on 'Low Carbon Africa', discussing the diverse pathways to low carbon energy. Energy access is a key issue across the continent. Recently Kofi Annan launched the 'Africa Progress Panel' report that argued for a massive energy revolution in Africa, with the potential for technological leapfrogging to a low carbon future.

But the reality on the ground is less bright, and this imagined pathway to energy security through a universal-access, low carbon system is a way off. Load shedding is frequent even in major cities, and in rural areas off-grid have no access to electricity at all. Indeed, according to Cosmas Ochieng, Executive Director of the African Centre for Technology Studies, across Africa 620 million lack access to grid electricity.

This has major impacts. Economic growth is fuelled by energy. In agriculture, electricity supply is crucial for many irrigation systems, and intermittent supply can result in disaster. But more fundamental life and death challenges arise. John Magrath of Oxfam commented in a blog from Zimbabwe, reflecting on these ground realities:

"I was talking to a nurse at a rural health centre who described how the cost of two candles can be a matter of health or hunger, or even life or death. The health centre had no electricity, so expectant mothers were told to bring two candles with them to provide light for their delivery. Two candles cost a dollar, which is the same cost as going to the mill

to get your maize ground into meal for a family's dinner. Lacking a dollar, mothers-to-be naturally prioritised feeding their children over buying candles, and as a result, often left it too late to reach the health centre and gave birth on the road, at night".

Development agencies are now addressing energy poverty and access. The funding of low cost, decentralized, off-grid sustainable energy solutions – at health centres, in rural growth points, at irrigation schemes and at people's homes – can make a huge difference. Innovations in technology and finance are crucial. This is driving down costs and making access to low carbon energy sources achievable for a wide number of people. The cost of solar panels, and lighting sources such as solar lanterns, has gone down dramatically in recent years.

Financing models have been revolutionized too. In Nairobi, we heard from Julius Kipng'etich, CEO for the leading and innovative Equity Bank, which now operates across six African countries, and with ten million customers. He talked about how lending needs to be defined by a 'red line' that means unsustainable industries will not get finance. Lending instead will be channeled only to sustainable activities. Sustainability is 'not just CSR', he says, but 'the core business' of the bank. He wants to 'change the narrative' about what a corporate does.

In our work in Zimbabwe, we have been

amazed at the scale of investment in small-scale solar technologies. When we started tracking investment patterns in the new resettlement areas in the early 2000s, we didn't even have solar panel purchases on our standard census questionnaire, as they barely existed.

In 2012, we asked how many panels had been purchased by 280 A1 households in the five years before in our Masvingo sites, and a total of 170 panels were purchased, across 52% of households. Across 220 A1 households in Mazowe in 2014, 220 panels had been purchased in the past five years, and 74% of households had at least one solar panel.

Within a few years, I predict that nearly every household will have access to electricity through low-cost solar technologies.

Access to solar electricity is transforming people's lives. With lighting, kids can study for school after dark, stored energy can be used to help pump water, and of course mobile phones can be charged to facilitate agricultural marketing.

Ian Scoones: Professorial Fellow, STEPS Centre, the Institute of Development Studies, University of Sussex.

Caroline Kibii

The women can champion use of renewable energy

Women in Africa are excessively responsible for household duties like fetching firewood for heating, lighting and cooking. Most women, particularly those in rural areas, depend on natural resources. However, because of climate change challenges such as drought, deforestation and unreliable rainfall, these women are unable to access the natural resources. Human activities, including charcoal burning and industrial operations contribute to climate change. Women as well contribute to climate change while making ends meet for their families.

In Kenya, women can be efficient drivers of renewable energy. Their activities require sustainable and reliable as well as cheaper energy sources like solar. Those activities generate income to the women. Women operating fish businesses, particularly those dealing with omena, depend on the sun's heat to dry their fish. Often, women spread their fish along the lakeshore. It is common among women operating around Lake Victoria.

During rainy seasons, there is little to no sunlight, this means the omena will not dry. The longer it takes to dry, the less the amount of omena supplied to the market. The women end up losing money. Because of the high number of women in the omena business, it would be beneficial to establish drying mechanisms powered with solar energy. Solar energy can be stored for use during rainy seasons.

Most households in Africa still depend on kerosene as a source of lighting. Kerosene contains hydrocarbons that contribute to global greenhouse

gas emissions in the atmosphere causing global warming. Kerosene is not clean. It poses health implications. It causes respiratory problems. Kerosene is expensive.

Solar lanterns and solar panels have become common in the rural areas. People can satisfactorily watch television and listen to radios courtesy of solar power. Charging mobile phones, torches and powering mills is now easier with solar power.

Mobile service providers and innovators have teamed up to ensure solar power is accessible to persons living in the rural areas. Safaricom Limited, one of the largest mobile service provider in Kenya through its Mpesa mobile money transfer has made it easy for rural dwellers to light and power their homes and businesses with solar. By paying their solar lantern via Mpesa money has improved their living styles.

Climate change effects have led to inadequate firewood. Biomass energy from animal products should be encouraged. Every home in rural areas has at least a goat, sheep or cow. Women are responsible for cleaning animal droppings, which is mainly used to reduce biomass energy. Educating these women and supporting them establish biomass power plants in their homes will enable uninterrupted lighting, heating and cooking.

Poultry farming is a common venture among women. It would be expanded and strengthened when there is reliable supply of power. Biomass energy would enable women undertake the activity successfully. Biomass energy source is renewable, clean and sustainable. It can be used for light-

ing, cooking and heating at the same time. The energy sector has progressively improved. However, there is still an energy crisis. A significantly small percentage of renewable energy can be reported globally.

World Bank's global tracking framework report indicates that renewable energy accounted for only 18 percent of the global energy mix in 2010. A 1.3 percentage improvement was reported from 1990 to 2010. The figure needs to double.

World Bank further stated that 1.2 billion people globally had no access to electricity while 2.8 billion people rely on wood or other biomass for cooking and heating their homes. Fundamentally, 80 percent of this population is said to live in sub-Saharan Africa.

Because of the increasing energy poverty, various initiatives have been established targeting rural homes. Women are the main beneficiaries. President Barrack Obama's Power Africa project is a notable initiative that has already kicked off in most parts of sub-Saharan Africa.

RnB singer Akon through his initiative, Akon Lighting Africa, has recognized the energy inefficiency in Africa. The initiative that trains local African entrepreneurs and engineers on solar power productions aims to bring solar power to more than 600 million homes.

While it is clear that women can influence a drastic shift to renewable energy, it is important to consider women as equal partners in climate change decision-making processes.

Information is power. The more the women who understand the causes and effects of climate change, the higher the chances of developing mitigation and adaptation measures. In fact, women face the consequences of climate change more than men do.

Lack of energy impinges women's freedom. In order to attain this freedom, women can actively engage in advocating for cleaner energy.

Since women always want the best for their families. They will be willing to forego activities that deplete natural sources in order to preserve for future generations. Women are better in upholding sustainable resource utilization.

Nevertheless, governments should consider women as agents of change. Women should be considered to participate in all stages of strategising and executing energy development prospects and especially renewable energy.

Caroline Kibii is an environmentalist.

Barbara Grady

Reaching the base of the pyramid — and cutting carbon in the process

Ghana's per capita income is \$31 a week, according to the World Bank. But the roughly 500 female farmers who cultivate and harvest the leaves of moringa oleifera trees in the Tamale region of the West African nation earn five times that amount.

That's because the women supply ground leaves of the nutrient-rich moringa plant to Oakland-based Kuli Kuli Foods, which markets and sells energy bars, teas and nutrition supplement powders made from the "superfood" at stores including Whole Foods.

For the Ghanaian women who work at the beginning of the Kuli Kuli supply chain, skills such as hygienic food processing and packaging have helped both boost the products' utility in the local market, as well as given them a toehold in the global export market.

The farmers in the cooperative were previously subsistence farmers with very little power. Now, they are exemplary footsoldiers of the "base of the pyramid" model of economic development — a movement to start self-sustaining business operations in impoverished Third World communities.

"The poorest people in the world grow food for a living. The people at the base of the pyramid are all farmers, but subsistence farmers. So when you invest in those farmers you are lifting up their economy, giving them a way to earn an income," said Lisa Curtis, the 27-year-old founder and COO of Kuli Kuli Foods.

"For us, just the idea we have the opportunity to help people grow this plant that is incredibly nutritious and grow it right here where it was hardly eaten, and benefit from it and earn an income from it means a lot."

A former Peace Corps volunteer who learned about moringa from villagers when she served in Niger and suffered from a lack of vitamins, Curtis aimed to start a business where West African communities could benefit by their own enterprise.

Because Kuli Kuli pays what it considers fair wages, the company reports that farmers whose incomes rose are also buoying their whole village economy by spending on school fees, clothes and better food for their children. They are circulating wealth that wasn't there before and feeding aspirations of others to do the same. What's more, they're planting trees that function carbon sinks in the process of their work, illustrating how economic development done thoughtfully also can advance sustainability.

Back in Oakland, Kuli Kuli is also reaping the rewards of sourcing a unique product. As the first U.S. food manufacturer to use moringa as the major ingredient in food products, demand is growing quickly. Sales are on track to triple this year, Curtis said, and pass \$400,000 from the sale of \$2.99 health bars, teas and powder protein supplements in the U.S. Farmers keep about 25 percent of the moringa they grow for sale to the local market or for their families.

In the U.S., Kuli Kuli hits upon a few trends that are fueling that growth: consumer interest health foods — moringa has 15 vitamins and nutrients and 46 antioxidants — and a desire by consumers to buy products that do good (or at least less bad) in the world. The double bottom line approach is key to both the company's marketing and its success, which, in turn, has allowed Kuli Kuli to finance the Ghana farm cooperative's purchase of equipment needed to process foods for U.S. export.

"We're providing financing in the form of pretty large pre-payments, as well as loaning them money so they are able to do all of this work to meet our standards and then harvest the moringa," Curtis said.

Building the base

Kuli Kuli is part of a new crop of businesses engaging populations at the base of the pyramid.

Spurred by the same double-bottom-line instincts — and heightened consumer consciousness about what is happening at the other end of product supply chains — social enterprises are being formed by Western entrepreneurs as well as larger companies.

According to many economists, such efforts to set up quasi-independent manufacturing or production businesses are working to provide more than one-time Band-Aid approaches to world poverty.

Yet such enterprises typically battle similar obstacles that Kuli Kuli encountered working with farmers in places with no business systems or infrastructure in place. Those missing pieces, in turn, reinforce the very reason that under-developed economies remain under-developed.

Writing in Harvard magazine about business school author C.K. Prahalad's book "Fortune at the Bottom of the Pyramid: Eradicating Poverty through Profits," editor John Rosenberg describes a growing interest in launching social enterprises in the poorest of poor countries and how Prahalad and other theorists believe that private enterprise is the only way to lift them out of a cycle of poverty.

Still, enterprises in rural communities run into a host of infrastructure and business system deficiencies, from lack of all-season roads to bring goods to market to lack of electricity to the fact that most people in these rural areas don't use banks or have any cash flow.

Financing notoriously has been the biggest stumbling block; banks don't want to finance an enterprise whose goods may not make it to market or which might fall apart when electricity stops. Still, too, potential abounds in vulnerable poor areas for labor abuses, environmental degradation and other notorious supply chain ills.

The question now, as countries and businesses turn to the exigency of tackling climate change, is whether new approaches can address these ingrained challenges. In the meantime, businesses both big and small are watching to gauge how — or even if — new models can be implemented and paid for at scale.

Financing with a tool for another purpose

As governments buckle down to reduce carbon emissions and pass laws to stave off climate change, a new financing tool has emerged that could solve this logistical piece of the puzzle: income from carbon offset purchases.

Jonathan Shopley, managing director of the Carbon Neutral Company, said he is excited about the possibilities.

"In my experience, there are technologies that are incredibly relevant, but the expense of building them out can be formidable," Shopley said in an interview with GreenBiz.

But after 18 years in the business of packaging and selling carbon offsets that companies and countries buy to meet regulatory emissions reductions targets, Shopley is seeing a transformational impact of these offset purchases, aside from carbon reduction.

"One thing that defines a carbon credit is functionality — the direction of money to something that would otherwise not get money," Shopley said. "We have directed a lot of our clients' money to projects in developing countries, and it has shown us that financing appropriate delivered technologies that are being accepted in those projects can be transformative."

That's all possible because of the international system of carbon offsets that have grown up since the Kyoto Protocol was signed 18 years ago, along the trend of more national governments requiring large emitters to either pay carbon taxes or trade for carbon offsets. Carbon offsets have been evolving ever since, and Shopley's Carbon Neutral Company formed as the world's first business packag-

ing and selling carbon offsets to companies and consumers.

The Kyoto Protocol requires that carbon offsets, to be counted, must reduce carbon or raise opportunity in countries where no reduction targets were set because their economies are still developing. Signatories to the Protocol agreed to reduce carbon emissions by 5.2 percent from 1990 levels by the period 2008-2012.

Now, Shopley said, the world is beginning to see the value of these offsets not only as a way for large companies and countries to reduce carbon in a net global way, but as a financing tool for economic development in places where it is hard to attract capital.

Two successful projects he hopes to see replicated elsewhere are the SELCO India Pvt. Ltd. in rural India and the Ecofiltro water filter manufacturing plant in Guatemala.

SELCO's principles note on their website that India's rural banking system just didn't have a portfolio for financing solar lighting technology, and yet — as India strives to overcome the problems of scarcity of electricity — solar micro-grids are becoming the way that many villages, schools and standalone manufacturing projects in rural areas are getting energy.

SELCO provides solar in underserved communities. It finances these projects in many ways, but one increasingly popular way is developing packages of projects that can be sold as carbon offsets through the Carbon Neutral Company.

Shopley says similar social enterprise financing packages are being formed in Guatemala, Africa and throughout the developing world.

In Guatemala, one such effort receiving carbon offset money is Ecofiltro, a tiny company manufacturing water filters using technology applied to

locally available materials — clay pots — to create water filters. Manufactured locally by Guatemalans, Ecofiltro is not only improving health by expanding access to clean water, it is also providing jobs and a manufacturing infrastructure in the hills outside of Antigua, Guatemala.

One major differentiator between these enterprises and philanthropy or donations is an emphasis on economic empowerment, creating real job opportunities. "That is in stark contrast to philanthropic programs where filters are handed out," Shopley said.

Instead, Guatemalans are manufacturing the filters for their own communities and learning how to operate a sustainable business.

"Our experience with carbon offsetting is taking us directly into this space of locally based manufacturing, distribution, maintenance of appropriate technologies in country," he said. "We are getting to maximize return on the use of these technologies, reduc(ing) carbon through the carbon offset and help(ing) eradicate poverty."

Although one perennial sticking point with carbon offsets is the extra step of adding a rigorous mechanism to ensure that carbon is actually reduced, Shopley said that the approach — if done well — can pay dividends in other social and economic realms.

"You can build a series of co-benefits that are much more empowering," he said. "You can see a chain of how health benefits are supported or gender equality is supported."

Barbara Grady is a senior writer at GreenBiz.com.

Steven Sinofsky

Africa's mobile-sun revolution

The transformative potential for mobile communications is upon us in every aspect of life. In the developing world where infrastructure of all types is at a premium, few question the potential for mobile, but many wonder whether it should be a priority.

Many years of visiting the developing world have taught me that, given the tools, people — including the very poor — will quickly and easily put them to uses that exceed even the well-intentioned ideas of the developed world. Poor people want to and can do everything people of means can do, they just don't have the money.

Previously, I've written about the rise of ubiquitous mobile payments across Africa, and the work to bring free high-speed Wi-Fi to the settlements of South Africa. One thing has been missing, though, and that is access to reliable sources of power to keep these mobile phones and tablets running. In just a short time — less than a year — solar panels have become a commonplace sight in one relatively poor village I recently returned to. I think this is a trend worth noting.

It is also the sort of disruptive trend we are getting used to seeing in developing markets. The market need and context leads to solutions that leapfrog what we created over many years in the developed world. Wireless phones skipped over landlines. Smartphones skipped over the PC. Mobile banking skipped over plastic cards and banks.

Could it be that solar power, potentially combined with large-scale batteries, will be the "grid"

in developing markets, perhaps at least in the near future? I think so.

At the very least, solar will prove enormously useful and beneficial and require effectively zero-dollar investments in infrastructure to dramatically improve lives. Solar combined with small-scale appliances, starting with mobile phones, provides an enormous increase in standard of living.

Infrastructure history

Historically, being poor in a developing economy put you at the end of a long chain of government and international NGO assistance when it comes to infrastructure. While people can pull together the makings of shelter and food along with subsistence labor or farming, access to what we in the developing world consider basic rights continues to be a remarkable challenge.

For the past 50 or more years, global organizations have been orchestrating "top down" approaches to building infrastructure: Roads, water, sewage and housing. There have been convincing successes in many of these areas. The recent UN Millennium Development Goals report demonstrates that the percentage of humans living at extreme poverty has decreased by almost half. In 1990, almost half the population in developing regions lived on less than \$1.25 a day, the common definition of extreme poverty. This rate dropped to 22 percent by 2010, reducing the number of people living in extreme poverty by 700 million.

Nevertheless, billions of people live every day without access to basic infrastructure needs. Yet

they continue to thrive, grow and improve their lives.

While the efforts to introduce major infrastructure will continue, the pace can sometimes be slower than either the people would like or what those of us in the developing world believe should be "acceptable."

A village I know of, about 10 miles outside a major city in southern Africa, started from a patch of land contributed by the government about six years ago, and grew to a thriving neighborhood of 400 single-family homes. These homes are multi-room, secure, cement structures with indoor connections to sewage. The families of these homes earn about \$100-\$200 a month in a wide range of jobs. By way of comparison, these homes cost under \$10,000 to build.

While the roads are unpaved, this is hardly noticed. But one thing has become much more noticeable of late is the lack of electrical power. Historically, this has not been nearly as problematic as we in the developing world might think. Their economy and jobs were tuned to daylight hours and work that made use of the energy sources available.

In an effort to bring additional safety to the village, the citizens worked with local government to install solar "street lights," such as the one pictured here. This simple development began to change the nighttime for residents. These were installed beginning about nine months ago (as seen in the first photo, with a closer to production installation in the second).

Historically, this type of infrastructure, street lighting, would come after a connection to the electrical grid and development of roads. Solar power has made this "reordering" possible and welcome. Lighting streets is great, but that leads to more demands for power.

Mobile phones, the new infrastructure

These residents are pretty well off, even on relatively low wages that are three to five times the extreme poverty level. While they lack electricity and roads, they are safe, secured and sheltered.

One of the contributors to the improved standard of living has been mobile phones. Over the past couple of years, mobile phone penetration in this village has reached essentially 100 percent per household, and most adults have a mobile.

The use of mobiles is not a luxury, but essential to daily life. Those that commute into the city to sell or buy supplies can check on potential or availability via mobile.

Families can stay connected even when one goes far away for a good job or better work. Safety can be maintained by a "neighborhood watch" system powered by mobile. Students can access additional resources or teacher help via mobile. Of course, people love to use their phones to access the latest World Cup soccer results or listen to religious broadcasts.

All of these uses and infinitely more were developed in a truly bottom-up approach. There were no courses, no tutorials, no NGOs showing up to "deploy" phones or to train people. Access to the tools of communication and information as a platform were put to uses that surprise even the most tech-savvy (i.e., me). Mobile is so beneficial and so easy to access that it has quickly become ubiquitous and essential.

Last year, when I wrote for Re/code about mobile banking and free Wi-Fi, I received a fair number of comments and emails saying how this seemed like an unnecessary luxury, and that smartphones were being pushed on people who couldn't afford the minutes or kilobytes, or would much rather have better access to water or toilets. The truth is, when you talk to people who live here, the priority for access unquestionably goes to mobile communication. In their own words, time and time again, the priority is attached to mobile communications and information.

Fortunately, because of the openness most governments have had to investments from multi-national telecoms such as MTN, Airtel and Orange, most cities and suburban areas of the continent are well covered by 2G and often 3G connectivity. The rates are competitive across carriers, and many people carry multiple SIMs to arbitrage those rates, since saving pennies matters (calls within a carrier network are often cheaper than across carriers).

Mobile powered by solar

There has been one problem, though, and that is keeping phones charged. The more people use their phones (day and night), the more this has become a problem. While many of us spend time searching for outlets, what do you do when the

nearest outlet might be a few miles away? When there is an outlet, you often see people grouped around it, or one person volunteers to rotate phones through the charging cycles. Here's a picture of an outlet in the one building connected to power, the community center. This is a pretty common sight.

An amazing transformation is taking place, and that is the rise of solar. What we might see as an exotic or luxury form of power for hikers and backpackers, or something reasonably well-off people use to augment their home power, has become as common a sight as the water pump.

The plethora of phones sharing a single outlet has been replaced by the portable solar panel out in front of every single home.

An interesting confluence of two factors has brought solar so quickly and cheaply to these people. First, as we all know, China has been investing massively in solar technology, solar panels and solar-powered devices. That has brought choice and low prices, as one would expect. In seeking growth opportunities, Chinese companies are looking to the vast market opportunity in Africa, where people are still not connected to a grid. There's a full supply chain of innovation, from the solar through to integrated appliances with batteries.

Second, China has a significant presence in many African countries, and is contributing a massive amount of support in dollars and people to build out more traditional infrastructure, particularly transportation. In fact, many Chinese immigrants in country on work projects become the first customers of some of these solar innovations.

People are exposed to low-cost, low-power portable solar panels and they are "hooked." In fact, you can now see many small stores that sell 100w panels for the basics of charging phones. You can see solar for sale in the image below. I left the whole store in the photo just to offer a bit of culture. The second photo shows the solar "for sale" offers.

Like many significant investments, there's a vibrant market in both used panels and in the repair and maintenance of panels and wiring. Solar is a budding industry, for sure.

But people want more than to charge their phones once they see the "power" of solar. Here is where the ever-improving and shrinking of solar, LED lights, lithium batteries and more are coming

together to transform the power consumption landscape and the very definition of "home appliances."

In the developed world, we are transitioning from incandescent and fluorescent lighting in a rapid pace (in California, new construction effectively requires LED). LED lights, in addition to lasting "forever," also consume 80 percent less power. Combining LED lights, low-cost rechargeable batteries and solar, you can all of a sudden light up a home at night. Econet is one of the largest mobile carriers/companies in Africa, and has many other ventures that improve the lives of people.

Here are a few Econet-developed LED lanterns recharging outside a home. This person has three lights, and shares or rents them with neighbors as a business. Not only are these cheaper and more durable than a fossil-fuel-based lantern, they have no ongoing cost, since they are powered by the sun.

With China bringing down the cost of larger panels, and the abundance of trade between Africa and China, there's an explosion in slightly larger solar panels. In fact, many of the homes I saw just nine months ago now commonly sport a large two-by-four-foot solar panel on the roof or strategically positioned for maximal use.

Panels are often on the ground, because they move between homes where the investment for the panel has been shared by a couple of families. This might seem inefficient or odd to many, but the developing world is the master of the shared economy. Many might be familiar with the founding story of Lyft based on experiences with shared van rides in Zimbabwe, Zimride.

Just the first step

We are just at the start of this next revolution at improving the lives of people in developing economies using solar power.

Three sets of advances will contribute to improved standards of living relative to economics, safety and comfort.

First, more and more battery-operated appliances will make their way into the world marketplace. At CES this year, we saw battery-operated developed-market products for everything from vacuum cleaners to stoves. Once something is battery-powered, it can be easily charged. These innovations will make their way to appliances that

are useful in the context of the developing world, as we have seen with home lighting. The improvement in batteries in both cost and capacity (and weight) will drive major changes in appliances across all markets.

Second, the lowering of the price of solar panels will continue, and they will become commonplace as the next infrastructure requirement. This will then make possible all sorts of improvements in schools, work and safety. One thing that can then happen is an improvement in communication that comes from high speed Wi-Fi throughout villages like the one described here. Solar can power point-to-point connectivity or even a satellite uplink. Obviously, costs of connectivity itself will be something to deal with, but we've already seen how people adapt their needs and use of cash flow when something provides an extremely high benefit. It is far more likely that Wi-Fi will be built out before broad-based 3G or 4G coverage and upgrades can happen.

Third, I would not be surprised to see innovations in battery storage make their way to the developing markets long before they are ubiquitous in the developed markets.

Developed markets will value batteries for power backup in case of a loss of power and solar storage (rather than feeding back to the grid). But in the developing markets, a battery pack could provide continuous and on-demand power for a home in quantity, as well as nighttime power allowing for studying, businesses and more. This is transformative, as people can then begin to operate outside of daylight hours and to use a broader range of appliances that can save time, increase safety in the home and improve quality of life.

Our industry is all about mobile and cloud. With the arrival of low-cost solar, it's no surprise that the revolution taking place in developing markets these days is rooted in mobile-sun.

Steven Sinofsky is a board partner at Andreessen Horowitz, an adviser at Box Inc., and an executive in residence at Harvard Business School.

Marcia Pledger

Former political activist Thione Niang turns co-founder of Akon Lighting Africa: Reinvention

Five years ago, Thione Niang met with friends on Carnegie Avenue and proposed launching a global initiative to change the world by empowering youth leaders and future entrepreneurs. His friends thought he was crazy and refused to buy into his global vision.

Yes, they knew he was the first African American elected president of Cuyahoga County Young Democrats in 2007. They knew he volunteered for various political campaigns, served as campaign manager for Sen. Shirley Smith, and advised Congresswoman Marcia Fudge on youth issues and education in 2009. They knew he believed in President Barack Obama in the early days when he was a senator and Niang tried to fill a room at his alma mater, Cuyahoga Community College, but only youth showed up.

"Me and my friends tried to meet to organize it. But then they left it. They said, 'you're trying to do some crazy things, talking about helping young people all over the world. We don't have that kind of money.' They thought I was crazy and let it go. They're all still here now," said Niang, 37.

Niang moved to Washington, D.C., that year. He held on to his dream, then turned it into a reality.

In the past five years, this Senegalese-born political strategist has traveled to 72 countries as founder of the Give 1 Project. Today it's in 30 countries with more than 24,000 members. Last month marked the fifth year he's brought young leaders from all over the world to the White House.

Niang, like millions of other immigrants who came to America, came here to escape poverty and create a better life. He grew up in a polygamist family, his father having three wives and 28 children. They lived in a three-bedroom home with no energy source. Rice was often the only food for four or five days, and he studied at night by candlelight when he could. Mostly, he woke up early to study by sunlight. He never forgot those years, or the 600 million Africans who are still without power.

Two years ago, he changed his career focus. Now, along with R&B superstar Akon, and Samba Batily, CEO of solar energy solutions company Solektra, he's co-founder of Akon Lighting Africa. It's a unique business model that offers solar kits to households and small communities. They're pre-financed with a \$1 billion credit line with international banks and financial partners.

"You have to think big, bigger than yourself," Niang said nonchalantly. "Anything that you can think of is possible."

But even with this venture, this youth empowerment activist is among a trio that's finding ways to empower others. They're providing clean energy in the form of solar panels, street lights, and micro-grids to rural areas in Africa that have no access to electricity. Just as important, they're training people in those communities to serve as installers for the energy project.

It's a business that's also giving back in the form

of education, employment, and donations such as computers to schools. Earlier this year, they created a school in Mali, Africa, to train people in all aspects of renewable energy, business, engineering and installation.

So far in just two years, Akon Lighting Africa is in 15 countries in Africa, and about 5,200 people are working to install and maintain the lights.

"We're working hard to electrify thousands of villages in Africa," said Niang, who was just nominated as an Ambassador by the Department of Energy.

Niang says he'll never forget all of the people in Cleveland who helped shape who he is today. They include a restaurant manager at David's at the downtown Cleveland Marriott, who helped him find his first professional job at 22 as a French teacher at a charter school. He was working as a busboy and going to Tri-C at the time when he was asked to come from the kitchen area, put on a suit jacket, and temporarily serve as a host. He was the only one on staff who spoke fluent French and the restaurant was filled with French-speaking patrons visiting the Cleveland Clinic. They were also Africans who didn't understand the cultural difference of tipping until Niang explained it to them.

That first job as a teacher led him to taking Cleveland students to Senegal each year. And years later, when some Glenville students got into trouble with the law and later had difficulties finding jobs, he wanted to learn more about politics and find ways to help youth. That led him to volunteer on local political campaigns.

He's grateful for people such as Cleveland City Councilman Kevin Conwell, who helped him get a one-year job as a community organizer in Glenville when another politician turned his back on him after volunteering for his political campaign for a year. Niang said he was hurt at the time, but that was among many temporary setbacks that made him work harder and dream bigger.

Niang was accustomed to overcoming obsta-

cles. He's the only one of his 27 siblings who moved to America. After his visa was denied four times, he came to this country in 2000 with just \$20 and couldn't speak much English. He stayed with a Senegalese taxi driver for a few months and saved \$800 working as a bus boy in New York before moving to Cleveland with a student visa.

"Don't let anyone tell you what you can and can not do ... You have to focus on solutions and stay persistent."

How do you relax and unwind?

I love nature. I travel around the world trying to reconnect with nature. I enjoy the countrysides.

What is your goal for Akon Lighting in the next five years?

The goal is to be in 40 countries in Africa by 2020.

What are the three apps you use most?

Instagram, Whatsup and Google Maps.

Tell us what you love most about Cleveland?
Cleveland is resilient.

What would you tell your younger self?

Seek out a mentor.

Do you have one piece of advice for someone considering reinventing?

Think big because everything is possible, if you are willing to put the work in. And don't listen to naysayers. You can do anything, even without a support system, because I didn't have a support system. But I believed in the possibilities. And never stop dreaming, because once you stop dreaming you get complacent. You get comfortable. And that's when innovation dies off.

Marcia Pledger is a business reporter and columnist for the Plain Dealer.

Life

Vrinda Manglik

Beyond-the-grid is not just about light, it's about resiliency

At times when the grid fails, distributed generation offers a way to keep the lights on -- not only in areas beyond the reach of the grid but in cities as well.

People often highlight the cost-effectiveness and rapidity of deploying beyond-the-grid solar solutions. As the story goes, beyond-the-grid solar companies are providing power to rural places in developing countries where the grid hasn't yet reached and at a lower cost than other available options. But distributed generation has other important benefits: it can offer more reliability than a centralized grid, too.

Following Superstorm Sandy, which pummeled the eastern seaboard of the United States and the Caribbean and left 8.1 million homes without power, the term "grid resiliency" gained new popularity as utilities and regulators scrambled to think about how to modernize the grid to avoid blackouts in places following superstorms of the future.

Modernizing the grid wasn't the only lesson from Superstorm Sandy, though; the reliability of distributed generation solutions was revealed as well. As Stephen Lacey wrote about in Greentech Media's e-book, Resiliency: How Superstorm Sandy Changed America's Grid: "But the [centralized electricity] system didn't fail for everyone. Scattered throughout the ruin, tiny pockets of resiliency formed -- proving that smaller, cleaner, distributed technologies can be a powerful defense against crises on the grid."

As Lacey's report shows, existing hybrid-solar storage systems provided power in some devastated areas of New York and New Jersey, and off-grid solar generators provided relief to many people without power as part of relief efforts.

The resiliency of communities using distributed generation has been proven after other storms as well. This is true both in major cities and in rural areas beyond the reach of the grid.

A recent example of this was highlighted by Kaliluri Bhanumathi, whose coastal city of Visakhapatnam in the Indian state of Andhra Pradesh was hit hard by last month's tropical Cyclone Hudhud. As Bhanumathi explained, the cyclone brought down trees, telephone poles, and buildings in her city, and left the city without power for a week. This affected other basic services such as water supply and communications as well.

However, Bhanumathi's family has a 5-kilowatt solar power generation system which continued providing power during and after Cyclone Hudhud. The fact that Bhanumathi's solar system remained intact meant that her household could maintain their own supply of clean water and cooked food. They had greater resilience to the storm than the rest of the city.

Emergency responses by the international community to disasters increasingly include bringing beyond-the-grid solar products to disaster-impacted areas. For example, solar streetlamps were brought into tent camps to enhance safety

following the massive earthquake that struck Haiti in 2010, and solar lamps were also distributed to thousands of families in the Philippines as part of the relief efforts following Typhoon Haiyan (Yolanda).

While disaster relief efforts are extremely important, we should see more beyond-the-grid solar home systems and lanterns as part of disaster preparedness and resilience-building efforts, rather than simply as a reaction to disasters. Distributed generation is more resilient in the face of storms like Superstorm Sandy, Cyclone Hudhud, and Typhoon Haiyan (Yolanda). And while distributed generation has provided niche resiliency for

communities hit by major storms, it can form the backbone of power systems for people living beyond the reach of the grid.

As we move into a stormier world, distributed solar can keep people safer -- while keeping the lights on.

Vrinda Manglik is an Associate Campaign Representative for the Sierra Club's International Program.

John Magrath

Solar is bringing a new world to women in Zimbabwe

A solar power project in a remote community in Zimbabwe is encouraging women to give birth in hospitals, and reducing their workload.

For a woman in parts of rural Zimbabwe the cost of two candles can be the difference between health and hunger, even life and death. Because many health clinics are far from the grid and lack electricity and therefore light, expectant mothers are told to bring their own candles when they feel that labour is approaching. But as primary care needs worker Merjury Shoko explains: "Two candles cost a dollar, which is the same as paying to go to the grinding mill to grind maize for your child's dinner. That is a real dilemma for some women. Do I go to the clinic now, or do I feed my children? It's obvious they prefer to go to the mill." As a result many women leave it until the last minute to walk to the clinic, and many do not make it in time and give birth by the roadside, often at night.

A solar power programme – the Rural Sustainable Energy Development Project (RuSED) – in isolated parts of Gutu district in southern Zimbabwe set out to change that. Five clinics were equipped with solar panels for lighting the wards, solar water pumping to provide clean water and solar refrigeration for vaccines. Now that women do not have to pay for candles they are happy to travel to the clinics in good time and the clinics report increases of up to 50% in the numbers of women giving birth there instead of at home, or by the roadside. What is more, if anything goes wrong the medical staff

can see properly to carry out life-saving procedures. Every staff member shudders when they recall what they went through before they had solar lighting – trying to find a vein or sewing up wounds by candlelight or even holding a mobile phone torch in their teeth.

It is not only women's maternal health that is being improved through the deployment of solar power, their productivity and efficiency as farmers is also affected. In semi-arid Gutu district, increasingly prone to serious droughts, women grow crops and sell them at Mazuru market garden, covering the ground for hundreds of yards in neat rows of vegetables. The women proudly show off the fruits of their labours and one of the hardest and most time-consuming labours of all is fetching water.

Each woman has 11 rows of crops that need daily watering. To do that she has to walk 400 metres to a reservoir and then back with a bucket on her head, it takes two to three trips to water one row, so she may take 20 to 30 journeys each day. This can take a gruelling six hours; from 7am until 1pm. That leaves little time for all the other essential work of hoeing, weeding and tending to the plants – and of course she must also make time for the household cooking and cleaning. The community did have a diesel pump to provide water to the garden but they couldn't afford the rising cost of fuel, and eventually it broke.

Now the women have enough money in their community energy fund to buy a solar water pump. With that they can come to the site at mid-

day when the tank has filled up and water their gardens within an hour or two. And they will not have to pay for diesel. Solar irrigation is already working well at other sites.

An innovative part of the RuSED programme is how to make it sustainable. Oxfam arranged solar equipment exhibitions so that suppliers could see there was a demand in rural areas and local people could test what was on offer and choose what suited them best. Solar lanterns, which are relatively cheap, as well as being portable and robust were very popular.

To prime the market Oxfam supplied the first batches of lanterns, and made sure they conform to international Lighting Africa standards of reliability. As part of the scheme each community has set up an energy fund and the proceeds from the sales of the lanterns are put into this to finance operation and maintenance costs and future expansion of solar power. More money for maintenance and expansion comes in from a variety of sources.

For example, schools and clinics with solar water pumps charge people to collect clean water. Furthermore, each community has a centre fitted with a solar panel and this powers an energy kiosk where people can recharge their lanterns and

mobile phones, as well as using the power for solar refrigeration.

Women have been enthusiastic about the benefits of an energy fund. Certainly, the 46 women involved in the Agro-Business Centre at Gomba village know the drawbacks and perils of using expensive and dangerous substitutes for green energy. Abigail Mawona describes how she sent one of her sons to fetch mealie meal by candlelight and he dropped the candle and burned their house down. Now the women have raised nearly \$17,000 and invested it in buying a "solar suitcase" (a portable solar medical kit) for their nearest clinic, building toilet blocks and purchasing a fridge for their fish-farming enterprise.

It is hoped that the "solar system" will show other villages in Zimbabwe the benefits of being energised through solar power, with a virtuous circle of increased production, better health and increased finances.

John Magrath is a programme researcher at Oxfam GB.

Karen Fasimpaur

Living a good life beyond the grid

When the rural homesite she loved turned out to be a mile (and \$80,000) from the nearest power line, Karen Fasimpaur found an alternative: solar energy. A Southwestern homesteader describes how she makes a living in the information economy while living off the grid.

When I tell people I live "off the grid," I get a variety of responses. Many are some iteration of "Wow! That is so cool. But what does that actually mean?"

In my case, it means we are not physically connected to the electrical grid. Instead, we rely exclusively on solar power and propane to provide energy for our household.

We do have landline phones and Internet access, but the power to run all of this comes from solar. (In a future article, I will write about how we connect to the telecommunications network and some of the policies that make that possible for us.)

It was never really a goal of mine to live "off the grid," but when we found a piece of land in eastern Arizona that we fell in love with, it turned out that it was about a mile from the nearest power lines, and there is no public policy that requires electrical companies to provide grid access. When we looked at the cost of bringing electrical power to our site, it was approximately \$80,000. That made solar an easy choice for us. While the robust solar installation we ended up with will never pay for itself in terms of the electrical bills that we don't incur, it was cheaper than bringing in a grid connection.

There are many reasons people choose to go

solar. Besides environmental and cost concerns, aesthetics can be a factor. There are no electrical poles and wires obscuring the natural beauty. Other people already established here were keen that we not bring in electricity to limit the impact of development. (Folks here like their isolation, and accessible electricity might draw a disruptive number of other residents.)

Before choosing solar components, we looked at many houses that were running on solar to see the options. We found people with everything from a bare-bones set up of a couple panels and a few car batteries to much more elaborate systems.

Working in a field that required a computer and Internet connection, we hoped for a set up that was just like a "normal" house. So we needed a solar system that was more toward the deluxe end of the spectrum.

I remember vividly when we had a local solar installer talk with us. He looked at our computers and said, "You'll never run all that on solar."

We opted to design and configure the system ourselves. About a year later, we did, in fact, have "all that" and more running on solar.

We put considerable effort into estimating our power usage, thinking about how we could economize on power without sacrificing quality of life, and evaluating different system components that would support our needs. Our system now consists of 12 210-watt solar panels that gather and convert the sun's energy, 24 12-volt batteries that store the electricity, and an inverter that converts the electricity into a form we can use. (It's worth

noting that people who want to go solar but are on the grid can avoid the cost of the batteries and the inverter.) Our solar system supplies nearly all of the power we need, and our batteries are generally fully charged before noon each day.

We do use propane for a few things that require large amounts of energy, like our flash hot-water heater and our stove. We have a fireplace (it's a building code requirement to have some source of heat), but we rarely use it except for ambiance. We also have a backup generator that we seldom use.

Through this experience, I've come to believe that going solar is completely feasible, and I'm surprised our nation hasn't made a bigger commitment to that goal.

One of the big lessons I've learned is that energy efficiency may be the most important consideration. In fact, I think that we could reduce our carbon footprint as much through energy conservation as through alternative energy sources. Energy is like many other natural resources that are priced relatively low. It's so cheap, we don't have an economic incentive to think much about conservation until there is a crisis.

Because our house was new construction, we could build in other ways to conserve energy. We

built thick, super-insulated walls. We rarely need heat and have no air conditioning, even though it gets well below freezing in the winter and into the 100s in the summer.

We also made sure to get appliances that are energy efficient, and we use mostly compact fluorescent light or LED bulbs, which require much less energy than traditional incandescent bulbs. I hang my clothes to dry outside and try to do activities that require a lot of power during the daytime hours, since we have excess solar power when the sun is up. I also cook what I can with electricity rather than on the propane stoves.

Having said that, if you came to our house, you wouldn't really know that it was off the grid. We have normal power outlets and every kind of appliance that you can imagine. Living off the grid doesn't have to mean living a Spartan existence or separating yourself from the information economy. For us, it has been a very feasible and rewarding way to live.

Karen Fasimpaur is independent consultant.

Harald Schützeichel

No grid? No problem! Full power access without the grid

The dream of most people who live off-the-grid is to be one day on-the-grid. The expectations from full power access are large: enough electricity for lighting, communications, entertainment, and livelihood. The connection to the grid represents the hope of a better life because full power access means that households, companies and communities have sufficient, affordable and reliable supply of all energy services and products which are needed to reduce poverty related to the lack of energy.

Sometimes governments take advantage of this high symbolic value of power grid and install, shortly before elections, at least the power poles. So they suggest: the electricity will also come to you - if you vote correctly.

Bad news

When the current flows, the reality is, however, often sobering: the connection to the grid is expensive and therefore has to be heavily subsidized in order for a household to be able to pay for the connection at all. For example, the connection to the electricity network in Kenya costs around \$830. Far too expensive for many households. The price is therefore artificially subsidized by Kenyan Power to \$400. Still more than what a solar home system costs – and in addition there will be monthly follow-up costs.

Once you are connected, the household budget is often merely sufficient to operate two or three

lamps. But that ultimately does not matter, because the feeling to be connected to the potential for more is what really matters for people. Too bad that the power supply is very unreliable, often fails and therefore people often sit in the dark despite the grid connection.

Besides, we won't be able to spare most people in developing countries the bitter truth that the hope for a network connection will never become a reality for them. Simply because the costs of connecting many remote regions are too high.

Good news

The good news for people in off-grid regions is that a technical alternative is available: full power access through solar-based off-grid solutions.

The disadvantage of this technically optimal alternative: it has the image of being only a kind of "first aid" since off-grid solar power is today predominantly marketed with small mini-systems, which consist either of mobile lamps or micro systems with 2-3 LED. This is of course better than nothing - and no household will resist taking this first help. But it is not enough to cope with the promise of the power grid that you can now (theoretically) have full power access, which allows an access to prosperity, development and a better life.

The bad thing: solar-based off-grid solutions could thoroughly provide this full power access! For the power requirements for lighting, refrigeration, entertainment, communication, economic

and communal life no expensive power grid is needed. And in contrast to grid, this full power access would even be affordable without subsidies and also reliable.

Stand-alone solutions for developing countries have the image of being only a "first aid" not only for off-grid customers: also governments, investors, power companies, banks (in particular the World Bank and IFC) see the stand-alone technique more as a temporary solution. The large capital flows go to network-based technologies. At most, the micro-grid is still accepted as "little brother". And on the other hand, the fact that the few investment funds, used for stand-alone technologies, go only to micro systems (especially mobile hand lamps) and not to full power access, contributes to the stabilization of the negative image of being a "substitute".

Full power access without the grid

Maybe a change in this attitude that the grid or micro-grid provides the only solution for a modern power supply will come ultimately again from the technically developed countries: because in Europe solutions are increasingly being implemented to make households and businesses independent from the public power grid. Many people see in

stand-alone systems, the future for a reliable and affordable energy supply in industrialized countries. The grid, with its large central power plants, is outdated technology of the 20th century. Independent, decentralized power supply units are the future.

The players in the off-grid industry in developing countries should rediscover and implement with more self-confidence the wish of their customer to get full power access. For, stand-alone solar technology offers to these people, far more than the old grid power technology, the chance of affordable and sustainable full power access. That would be - after the first wireless revolution with the spread of mobile phones - the second wireless revolution!

What a signal it would be if the wireless revolution in the power supply would come from the developing countries and not from the industrialized nations!

Dr. Harald Schützeichel is founder of the Solar-Federation (www.solar-federation.org) and editor of Sun-Connect News.

Rodrigo de Oliveira Andrade

Indoor air pollution may kill 4 million a year

Household air pollution may have caused around 4.3 million premature deaths from respiratory diseases in 2012, mainly in developing countries, according to a medical paper.

Such pollution dramatically increases the risk of both children and adults contracting chronic obstructive pulmonary disease (COPD), says the paper, published online last month in *Seminars in Respiratory and Critical Care Medicine*.

The conclusions are based on an analysis of medical studies about the respiratory effects on people exposed to household air pollution.

Around three billion people cook and heat their homes using unprocessed solid fuels such as wood, animal dung and crop waste, the study says. These are normally burned in open fires or simple stoves in rooms or huts with insufficient ventilation.

As a result, people breathe in high levels of pollutants, the researchers say, including particles of soot small enough to penetrate deep into the lungs, which is especially dangerous to children. "

"A low lung function value at an early age seems to be a risk factor for developing chronic obstructive pulmonary disease later in life," says Akshay Sood, a medical researcher at the University of New Mexico, United States, and one of the article's authors. "This may explain the occurrence of indoor air pollution-related COPD in younger adults as compared to tobacco smoke-related COPD, which usually occurs at an older age."

High levels of pollution from cooking and heating were associated with two major forms of COPD: chronic bronchitis and emphysema. But

exposure to indoor pollution might also make people more susceptible to another form of obstructive airway disease called bronchial anthracofibrosis, the researchers concluded.

Young children and non-smoking women from parts of Africa, Asia and the Middle East are the most likely to contract this disease, the study found. That is because they spend more time at home than men, meaning they inhale more indoor air pollution produced by unventilated and inefficient stoves.

Apart from causing pain and fever, COPDs limit lung growth in children, which can result in chronic health problems such as shortage of breath and tiredness.

Health problems can be avoided by using clean fuels such as liquid propane, natural gas or electricity, the study suggests. But Sood says such fuels may be unavailable or affordable to many low-income people.

Rodolfo de Paula Vieira, who researches lung disease at the University of Nove de Julho in Brazil, says the study shows the need for public policies to ensure people can afford better stoves.

Improving wood-burning stoves, particularly their exhaust systems, would lower the concentration of harmful particles inside homes and stop people from developing lung disease, he says.

Rodrigo de Oliveira Andrade is Latin America correspondent at SciDev.Net.

John Magrath

Solar irrigation and refrigeration - improving incomes in Zimbabwe

Water is life, and access to water is fundamental to the fertility of farmlands and the prosperity of their farmers. But getting water from A to B can be a backbreaking task.

At Mazuru market garden in Gutu district of Zimbabwe, neat rows of vegetables stretch for hundreds of yards, forming a rich green carpet. The women working there proudly hold up and show off the fruits of their labours for the visitor to admire. But it is indeed hard labour that has produced this harvest, and one of the hardest and most time-consuming labours of all is fetching water.

Each woman has 11 rows allocated and in the dry season each row needs watering every day. Each woman has a walk of some 400 metres to the dam and then back, carrying a bucket of water on her head. It takes two to three trips to properly water one row, so it may be necessary to make 20 to 30 journeys to the lake each day. With a heavy bucket of water on her head a woman may walk 4 kilometres or more. This can take a gruelling six hours; women will start watering at 7 a.m. and not finish until 1 p.m. That leaves little time for all the other essential work of hoeing, weeding and tending to the plants - and cultural norms dictate that they are also responsible for the household cooking and cleaning.

They had a diesel pump that used to provide water to the garden but they couldn't afford the

rising cost of diesel, and eventually the pump broke down.

Now the women have decided to use the money in their Community Energy Fund to buy a solar water pump which Oxfam is going to install. Jonathan Njerere, Oxfam Programme Manager, explains that with a solar pump women will be able to come to the site at mid-day when the tank has filled up and be able to water their gardens within an hour or two. And of course the gardeners will not have to pay for diesel.

The women of Gomba village have been at the forefront of the solar energy programme and have raised almost \$17,000 in their fund to reinvest in solar energy products, including a solar fridge for their fish farming enterprise. The benefits of solar have been more than economic. As one of the women says, "this has challenged us to use our minds and be innovative in terms of raising funds that we can contribute to the group, and now even the appearance of our households looks better".

Solar water pumping is one aspect of a four-year long programme led by Oxfam called RuSED, the Rural Sustainable Energy Development Programme, funded by the EC and by Oxfam, that aims to not only provide people with electricity but devise ways in which they can maintain the solar systems after Oxfam has gone. One crucial way is to use the electricity for production and income generation.

The potential of irrigation is being realised on

an even bigger scale at the Ruti dam irrigation site. There 60 hectares are being watered and cultivated and the results have been remarkable, and demonstrate the way 270 smallholder farmers who were previously growing little more than subsistence crops of maize can feed themselves, earn income and benefit their neighbours.

Two thirds of the Ruti scheme benefit from gravity-fed irrigation and now a third phase of production is well under way using two solar booster pumps that pump water to a night storage reservoir.

Irrigation enables farmers to grow three crops a year, and rotate crops to grow a diversity of food crops and cash crops like potatoes and sugar beans. Jeffrey Chara, irrigation scheme Treasurer, said:

"This year we have harvested four to five tons of maize per hectare but we have harvested nothing on our dry land plots because of the drought because of climate change - and that is on top of the other bad drought recently [2013]".

He says: "Our lives have changed significantly in all aspects. We are eating well and we are healthy and strong and we are working together as a family, husband and wife".

An Oxfam evaluation in 2012 found that household incomes had increased by 286% for the

very poor, 173% for the poor and 47% for the middle income groups.

The scheme also hosts an Energy Kiosk powered by rooftop solar panels which is providing cold storage. Across Gutu district similar Energy Kiosks that Oxfam has supported are enabling other enterprises to take off, from sewing to shops able to open for longer, while solar panels on the roofs enable the kiosks to earn a regular income from recharging lantern and mobile phone batteries.

In this way Oxfam aims to help people create a 'solar system' in the district that will be self-sustaining as it enables people to increase production and expand enterprise, and bring in income to pay for more solar products and to maintain them. The hope is that this will be a model for other rural off-grid communities throughout the country and influence the government's rural electrification and renewable energy strategies.

John Magrath is a programme researcher at Oxfam GB.

Jamie Cross

Why solar lanterns can't compete with the grid: Life without light in rural India

Ghanda sometimes wakes long before dawn to sweep her house and beat the husk off her rice. Now in her 70s, Chanda has long since lost her sight. The sound of her morning activities reverberates down the narrow, unpaved street of the Adivasi colony, through the mud brick walls of the homes stacked either side, waking her neighbours. Next door, Leena complains but is sympathetic. "Living without electricity is like being blind," she says. "You move around your home and cook without being able to see. Even in the day it is the middle of the night."

Ducking into the home that Leena shares with her husband, you quickly appreciate the analogy. Two beams support a low roof made from a blue tarpaulin and corrugated iron sheets. The windowless walls offer some protection from the winter cold and the monsoon rain. They also keep the daylight out. Leena cooks on three polished stones at the back of her house, balancing her pots over a small open fire that have long since blackened the ceiling. Even at noon with the wooden door wide open, her kitchen sinks into the gloom.

Leena's mother once made castor oil to light the inside of her home. She gathered the small orange seeds from plants in the hills, crushed them and boiled the grounds, skimming off the oil to burn in a clay lamp. Today, like everyone else in the colony, Leena burns kerosene. Each Wednesday, she carries a half-litre plastic bottle to the market, a three-kilometre walk away, and buys

enough fuel for the week. Each night, she lights it in a coopi, a lamp made from an old coconut oil tin.

This is the village of Goudaguda, nestled in a fertile valley amid the high plateaus of southern Odisha, India. More than half the population of 1,500 are Poraja Adivasis, an indigenous community who rank among India's poorest and most marginalised people. For many like Leena, life without electricity is most keenly felt in the home at night, when the kerosene lamps are lit. The use of kerosene lamps in rural India is associated with the risk of domestic fire and respiratory infection, but nobody in Goudaguda describes the risks in these terms. Many Adivasi houses are built to accommodate the use of kerosene and to mitigate the perceived danger of burning it indoors. Lamps are often placed in a small alcove called a tobo that has been built specially into the wall. At night, these keep the coopi's naked flame out of the reach of children and partially contain its noxious fumes.

The absence of electricity is also apparent during the day. Goudaguda's agrarian economy revolves around manual and unmechanised work, with no electrical appliances to ease the labour. The grains of millet, maize and rice harvested on the valley floor, for example, are all husked and polished by hand. Of course, on special occasions people generate their own electricity. During the Hindu festival of Ganesh Chaturthi or the Poraja harvest festival of Pus Parab, the Adivasis hire a

diesel generator from the nearest town, buying enough diesel to power a colony's worth of coloured lights and run a sound system all night long.

Yet Goudaguda is not entirely unelectrified. Like elsewhere in Odisha, one of India's poorest states, access to electricity here maps directly onto income and caste. In 1984, a line of wires and pylons first connected the homes of its richest families, the high caste Gouda farmers and traders who give the village its name, to the regional electricity grid.

Thirty years later, the supply of electricity is erratic and unreliable. But while the majority of Adivasi homes remain unconnected to the mains, Gouda homes have fans, televisions and plugs to charge mobile phones. More than these appliances, it is the simple electric lightbulb that makes energy inequality most visible to people here. Walking through the village at dusk, the light from Gouda homes can be seen from afar, spilling out over the threshold into the night.

In August 2012, I moved to Goudaguda with my wife and six-month-old son. Over five months, I recorded how access to electricity was tied up in the politics of village life. Before arriving here I had read studies, such as those published by the UK charity Practical Action, that proposed metrics for measuring poor people's energy access. But I had come across few attempts to understand the social relationships that shaped people's experience of energy poverty.

Many Adivasis here feel the lack of electricity in their homes prevents them from living a good or better life. Some blame the political and economic power of the Goudas for stymying their development. One day I accompanied Ballava, a soft, be-spectacled Poraja man in his late 40s, to a paddy field where he wanted to put up a scarecrow. "Only when the Goudas and their sons die will we prosper," he said, looking back to the village in which he had been born and the grove of mango trees opposite the colony where he had lived his whole life.

When my family and I left Goudaguda we bought solar-powered lanterns for Leena, Ballava and the others who had looked after us. Solar technology was increasingly common here. In neighbouring villages an Indian NGO had installed solar lantern charging stations and one of India's largest mining companies had distributed solar

lanterns as part of a corporate social responsibility campaign. The valley was also becoming a frontier market for companies selling branded solar lanterns as a cleaner, cheaper alternative to kerosene.

In January 2015, I returned to Goudaguda. Our solar lanterns had been welcome gifts. Yet neither here nor in the surrounding villages had they replaced the kerosene coopi. If the lanterns still worked, people were using them to supplement light from kerosene lamps at night, alongside candles and battery-powered torches.

Meanwhile, nobody imagined that access to solar-powered lighting had levelled energy inequalities. Instead, the solar lantern promised little but a second-class alternative to life on the grid.

Returning to the Poraja colony, I was surprised to see a line of wooden poles running down the middle of the street. Since my last visit to southern Odisha, a government-funded rural electrification programme was extending the regional electricity grid and connecting rural homes. But because Goudaguda was already part electrified, its Poraja colony had been deemed ineligible for the scheme.

With no immediate prospect of electrification, people had taken matters into their own hands. Ballava and others, I learned, had hunted down unused poles from across the valley and carried them home. If they could only show the government that they had poles the wires might follow, they hoped.

Any practical solution to the challenges of energy access must understand that energy poverty is a social relationship. In rural India, poor people's expectations for grid-like standards of electricity are shaped by local histories of inequality and exclusion. In the Adivasi villages of southern Odisha, nobody thinks a kerosene lamp or a solar lantern is sufficient to illuminate a home. People living without electricity don't just want to see in the dark, they want to live in light as others do.

Names have been changed.

Dr. Jamie Cross is a senior lecturer in social anthropology and development at the University of Edinburgh.

Lydia Limbe

Solar energy transforming lives in Kenya

Africa was dubbed the 'dark continent' due to the little knowledge that Europeans held about its populations and history. However, the phrase could be taking on a new meaning due to the fact that more than three quarters of the continent's population live in rural areas and aren't connected to the electrical grid.

According to World Bank fact sheet on Energy in Africa, some 25 countries in sub-Saharan Africa are facing a crisis evidenced by rolling blackouts. Although the African continent is well endowed both with fossil fuels and renewable resources, these are not evenly distributed, creating windfall profits for some countries and exacerbating the crisis in others.

The same report says 24 percent of the population of sub-Saharan Africa has access to electricity versus 40 percent in other low income countries. Even with these facts, solar energy is taking center stage in solving this need for energy, solving problems from reducing human-wildlife conflict to functional healthcare systems with the overall result being improved livelihoods.

Solar for health

Langata-Githurai hospital is a level three hospital situated in Githurai – Nairobi. For years it was literally deserted. It had many problems, one of them being inadequate support from the government to pay operational costs such as electricity. Client confidence plummeted, and so did their numbers.

With the new government that was voted in

two years ago, healthcare became a function of the devolved government, and the Kiambu County government decided to try a public-private-partnership in order to save and salvage the hospital. The partnership was with Philips, which installed solar panels and upgraded the hospital's equipment in use.

The solar panels produce up to five KVA of power, but the hospital only uses three kilovolts. Everything in the hospital is now powered by solar power including the sterilizing machine which is the biggest consumer of energy.

When the Africa Times correspondent visited the hospital, the solar system was being connected to a mobile application, enabling remote monitoring. The perimeter wall fence has LED lights which go on and off at a set time, and one of the clinical officers who only wanted to be identified by first name said that for the seven months the solar system has been working, there has been increased activity from the residents of Githurai, both in regards to the pursuit of healthcare as well as growing businesses around the area.

"On a slow day, we handle up to 150 patients per clinical officer. We are two. And because of the security lights, we have seen residential and commercial buildings coming up, new businesses operating until late. It's like a new township mushrooming," said Steve.

"Lion Lights"

This is not the only example of how solar energy is transforming lives in Kenya. In 2013, a Maasai

boy – Richard Turere discovered what was later dubbed ‘Lion Lights.’ From the age of nine, he was charged with the responsibility of herding and caring for his family’s large herd of cattle. His family lived within the Nairobi National Park’s proximity, in Kitengela, and that meant that they were among the families at a loss on how to protect their cattle from the constant raids by lions.

One night, as he was patrolling round the cattle boma (Swahili for enclosure) with a flashlight, he noticed that the lions kept at a distance. It then occurred to him that the lions may be afraid of flashing light, and got the idea to install lights that light alternately around the cattle enclosure.

He erected poles to form a sort of perimeter wall, connecting the wiring to an old car battery that’s solar powered, all of his own accord. At the time he was only 13, had no training nor a background knowledge in electronics or engineering.

Solar backpack

In rural areas, many people use wood fuel as well as kerosene to light up their homes. Kerosene is not clean energy, and the World Bank estimates that at least 4000 people die yearly as a result of using it.

Salim Visram knew this only too well, having grown up in Kikambala – Mombasa County before heading to Canada to study a Bachelor of Arts from the University of McGill. After witnessing for years, children walking long distances to school and living off the grid that she came up with the idea to design what has come to be known as the ‘Solar Backpack’. Salim designed this bag so that children living in rural areas can take advantage of the travel time to and from school to charge the solar panel attached to their bag, allowing them to use this energy to study at night.

The backpack has a solar panel storage battery connected to an LED lamp, which charges for four hours and provides light for up to eight hours. So far, she has distributed 500 backpacks in Kikambala Primary school, with the hopes of crowd-sourcing for funds to distribute thousands more.

Not only are rural communities embracing the use of solar power, but mega construction companies in Nairobi are now designing their plans around the generation and use of solar energy.

Garden City and Two Rivers, which are 32 and 102 acres of construction respectively, have designed their car ports such that the roofs are solar paneled, producing 1256 megawatt hour and two megawatt hours respectively.

Garden City, which is the first destination mall in Kenya, was opened on the 15th of September 2015 and the 3,300 solar panels are expected to produce approximately 1,246,000 kWh per year. It is predicted that this will reduce carbon emissions by an estimated 492 tonnes per year.

According to Anthony Ochieng, the Managing Director of Two Rivers Development, they are aware of their huge energy needs for this massive construction, “that is why the car port will be installed with solar panels, the output of which will be used to light common areas and also to power some of the escalators.”

Lydia Limbe is a freelance features writer who is based in Nairobi Kenya.

Jerry Abuga

Solar energy entrepreneur with keen eye for opportunity

AGVEP-supported entrepreneur in a small fishing town on the shores of Lake Victoria, North Tanzania, has seized the opportunity of the bustling economy of the area to utilise solar in diversifying businesses.

The small rural town of Mwelani in north-western Tanzania is abuzz with activity as residents engage in numerous commercial fishing ventures. The village centre, located on the shores of Lake Victoria, hosts a number of fish traders who come from all corners of the country to buy fish from small-scale fishermen in the area. The shops blend with surrounding homesteads to form a well-ordered lake front. A small fish landing site remains the major economic landmark in the area.

However, lack of main grid electricity has been a major challenge in the area, forcing innovative entrepreneurs like Meliki Zakaria Kadashi to adopt the use of solar power. Thanks to solar, Zakaria's business stays open late into the night, translating into more returns.

Since fish trading activities – like most commercial activities – rely heavily on mobile communications, many fishmongers in the village faced challenges with keeping their phones charged.

"Most people here have mobile phones but can't charge them. People often travel long distances in search of a charging facility. This makes solar phone charging a viable business in most rural areas in Tanzania", says GVEP's Tanzania Country Manager Adam Mbwambo.

Zakaria pondered on how to make the most of the growing clientele that the fledgling fish busi-

ness was bringing to the area. He thought of the communication frustrations fishmongers went through by remaining in a communication blackout for several hours when their phones went off. Initially starting off with two car batteries to charge phones, Zakaria would travel to Mganza, six kilometres away, to charge the batteries at \$0.1 (TZS 200). His business could not sustain the high costs.

From his savings, Zakaria bought a 75 Watts solar panel at the end of 2013 to power his business. He however did not have any knowledge on effective utilisation of solar power, including on the right accessories to use for optimum power generation and utilisation. Moreover, he never had records of his business and hence could not clearly assess its performance.

His enrolment in a GVEP enterprise support programme a year later transformed his business. Besides providing him with business mentorship and support, GVEP linked Zakaria to the Tanzania Postal Bank, where he was able to acquire a \$ 617 (TZS 1, 500,000) loan that he used to expand his solar phone charging venture.

"GVEP operates a small loan guarantee programme to support lending by local financial institutions to small businesses. These loans facilitate the purchase of solar equipment supplied by partners working with GVEP in Tanzania. Through solar power, the entrepreneurs are able to expand and diversify their businesses", says Adam.

Following GVEP's team's advice, Zakaria diversified into a number of activities including selling of airtime top up scratch cards and mobile money

transfer services. Zakaria also set up a pool table playing facility to tap onto the growing number of young people and fish mongers who didn't have much to do with their free time.

"Initially, I would charge between 10 and 15 mobile phones per day, but that number has now doubled. I am also able to light up to four bulbs in my house, as well as the pool business", he says.

The pool business with two playing tables attracts clientele up to late in the evening. It also provides employment for one young man who manages the business. On average, Zakaria makes \$2.5 (TZS 6,000) per day from the phone charging business and an average of \$7.2 (TZS 17,500) from the pool business. This is a leap from the previous \$4 (TZS 10,000) that he used to make. The improved income saw him clear his loan repayments in August this year.

Besides providing essential services like phone charging for businessmen during their stay in the area, Zakaria is currently building a guest house, enabling him to gain more income.

"Many fish traders who come here from distant

places have no place to stay when they travel here. I saw a business opportunity in that", he says.

Zakaria hopes to complete the venture by the end of this year. To date, he is comfortably paying school fees for his two children in elementary school.

Zakaria says the solar-powered business has brought life to the rural centre as both locals and fish buyers spend their spare time at the pool playing centre.

"In fact, safety has also increased here as most people stay up late into the night playing pool, as they listen to music both from the record player as well as from their phones", he says.

Jerry Abuga is the Communications & Knowledge Management Officer, East Africa at GVEP International.

Marianne Lavelle

Solar lights a healthy - and empowering - path in disasters

Clean energy's gains in technology and price offer hope and normalcy to those caught in strife and disaster, especially the world's 50 million refugees.

When disaster strikes, survivors have a few basic needs: food, water, shelter, blankets. But energy quickly becomes just as fundamental a need – and that is often lacking, or very dirty.

Breakthroughs in low-cost, solar lighting and mobile charging can improve the quality of disaster relief and refugee life around the world as never before, aid and development experts say. Rapidly falling prices and improved efficiency of three key technologies – solar photovoltaic cells, batteries, and LEDs (light emitting diodes) – have put renewable energy solutions within reach to improve health and welfare for millions of people.

"There has been an unprecedented scaling of access to energy for the under-served," said Russell Sturm, head of the energy access advisory for the World Bank's International Finance Corporation (IFC).

Portable solar

Over the past two years, he said IFC has seen some 150 percent annual growth in purchase of small-scale, mostly portable solar lamp products through Lighting Global, its program to spread clean and safe lighting to the 1.5 billion people in the world who live off the electric grid. About 7 million Lighting Global-certified solar lights and charging units have been sold in Africa, and probably an equal amount in Asia, Sturm said.

Some portable, water-resistant solar-powered LED lanterns are being sold in bulk for as little as \$6 to \$7 each, with eight hours of battery life, two-year warranties, and illumination 10 times brighter than a kerosene lamp. "The brightness has to be seen to be believed," said Leo Blyth, client services coordinator for Lighting Global, who demonstrated the technology for aid group leaders at a forum at the nonprofit United Nations Foundation earlier this month.

The technology could mean better environmental health for millions. Kerosene and firewood have been the go-to sources of lighting for years in refugee camps and relief sites in Africa and Asia – at great risk to health. Smoky, inefficient, and not portable, they're also dangerous.

"A huge risk in tent settings is fire and pediatric burns," said Richenda Van Leeuwen, executive director of energy access for the UN Foundation. Young children have also been sickened from drinking kerosene, sometimes sold in what looks like soda bottles.

Environmental health threat

As for firewood, the landmark Global Burden of Disease study published in 2012 in the Lancet confirmed that the greatest environmental health threat in the world is respiratory illness due to burning of wood, brush, dung, and other biomass for fuel. The 3.5 million annual deaths attributed to wood smoke are more than double the fatalities from either malaria (1.2 million) or HIV/AIDS (1.5 million).

Lack of safe, clean lighting even increases the risk of sexual assault for women, both because they are vulnerable in dark camps. The role that solar lights can play in addressing this issue became clear after the 2010 earthquake in Haiti that killed some 220,000 people and left 1.5 million homeless – one of the first disasters where aid workers were able to attempt large-scale distribution of solar systems.

"One of the things we saw in Haiti was that particularly for women and girls, having access to quality, sustainable lighting has been key to reducing gender-based violence in the aftermath of the earthquake," said Van Leeuwen.

More than 80,000 displaced by the earthquake in Haiti still live in temporary camps, five years after the magnitude 7.0 tremor, according to Amnesty International.

No harmful fumes

Most of the new solar lighting systems are designed to be portable, so they can be taken at night to toilet facilities. But the lights also can be hung or placed on stands to illuminate an area for children to read and study. Solar energy gives them a chance to do so without breathing harmful fumes.

"Years ago, we really didn't look so closely at how to tailor solutions to energy needs in emergency humanitarian settings," Van Leeuwen said. "With the advent of small-scale solar lighting, there are now many more solutions available for these settings." Now, aid workers recognize that one of the key steps of helping people in crisis is clean and safe energy.

Amare Gebre Egziabher, a senior environmental coordinator for the United Nations High Commissioner for Refugees (UNHCR), said the agency would like to see solar lanterns replace kerosene lamps, firewood and other problematic lighting choices.

His program has distributed thousands of solar lighting products in refugee camps in Syria, Gaza, and Rwanda, and elsewhere.

Corporate sponsors have stepped forward to help. Ikea, which through its Brighter Lives for Refugees campaign, is donating about \$1.20 (1 euro) for solar lighting from every LED bulb it sells through March to UNHCR's program. Panasonic and Pepsi also have sponsored campaigns to bring solar lights to refugees.

But Egziabher said funding remains a problem, given the number of people in need. The UN's latest figures show that last year there were 16.7 million refugees around the world and 33.3 million people displaced within their own countries. Syria's crisis, entering its fourth year in March, has displaced 6.8 million people.

Higher quality

Making sure that displaced survivors get solar lights that shine, batteries that last, and equipment that doesn't fry in the extremes of tropics or deserts has often been a problem – especially in fast-moving emergencies.

Comparing the new high-quality solar lights to some of the other choices on the market, Blyth said, is "like one of those movies where you see the humans next to the dinosaurs."

"Out there, you have the dinosaur products – they're using factory technology that may be 10 to 20 years old," he said. "They're there, they're cheap, and they're poor quality."

In many poor rural communities, people have come to believe, erroneously, that heavy batteries are more durable. But the opposite is now the case; the most advanced batteries are lightweight. "You probably had hundreds of thousands of these [old, heavy batteries] die in transit, sitting in refugee camps in your tent or storage point," said Blyth.

That's why one of Lighting Global's key efforts is a product testing and quality assurance program that so far has certified 49 different solar lighting and charging systems as part of its mission to support growth of clean off-grid lighting in the developing world. Its quality assurance ratings have provided guidance to governments and aid groups.

"We don't want containers full of junk coming into the market," said Sturm.

Bottlenecks and short notice

It has been a challenge both to spread information about high-quality, affordable solar lighting and charging technology to humanitarian aid groups, and to make sure that manufacturers have capacity to deliver clean energy solutions in a crisis.

"In many cases, large quantities need to be bought on short notice," said Arne Jacobson, Lighting Global's head of quality assurance. "Mean-

while, solar off-grid is an emerging industry, and many companies have small or medium-scale production capacity. That can cause bottlenecks."

Stephanie Cox, who has worked 15 years in international development, said that after Typhoon Haiyan hit the Philippines in 2013, many small humanitarian groups found it difficult to make bulk purchasing decisions on solar lighting.

"They ended up doing long Google searches and just ordering from the first hit, without knowing much about the product, or the company," or its ability to deliver the products ordered, she said.

Cox is founder of The Level Market, a business-to-business online platform launching later this year to attempt to connect buyers and sellers of humanitarian aid products.

\$150 per kilowatt-hour

Quality and manufacturing capacity issues may be nitty-gritty issues, but they're important, say solar lighting advocates, because of the risk that the renewable energy solution will get a bad repu-

tation before it even begins to reach its full potential in reaching those who need it most.

Ironically, the world's poor end up being gouged because of dependence on fossil fuel and inefficient wood energy – especially in emergency situations. Between the cost of kerosene and the prices at cell-phone charging stations, studies have shown the cost of power for people without grid electricity is the equivalent of \$150 per kilowatt-hour, Sturm said. That's 1,250 times what the average U.S. resident pays for home electricity, 12 cents per kilowatt-hour.

Solar energy offers hope that people in crisis can spend scarce resources on putting their lives back together, instead of wasting money on fuel.

Marianne Lavelle is a staff writer for The Daily Climate.

Business

Jennifer Stoneburgh

Lessons learned in scaling a social enterprise to solve energy poverty

On November 19, MaRS Mornings welcomed Jason Gray, the co-founder and CFO of SunFarmer. Jason didn't start out to be an entrepreneur, but by following his interests and playing to his strengths, he evolved into one. Starting off his career with Cargill, Jason learned lots about executive management, but couldn't find passion in the work. He moved to MNP, working with diverse clients before moving to Sun Edison, where he was the first Canadian employee of the young US startup. Through SunEdison, Jason had his first taste of startup life and was finally in a sector he cared deeply about.

After helping SunEdison grow rapidly, Jason saw an opportunity to combine his passion for renewable energy and desire for a startup culture through tackling energy poverty, a massive international issue. Over 2.4 billion people, or one-third of our global population, do not have reliable access to electricity. In excess of one billion people use health services without electricity, sometimes to treat the very respiratory illnesses caused by their reliance on wood, charcoal or animal waste to cook food.

SunFarmer was founded in 2013 with the goal to provide reliable and affordable energy to communities around the world. They currently have offices in Toronto, New York and Kathmandu. SunFarmer focuses on those areas of agriculture, health education and community infrastructure that are currently limited by a lack of reliable energy. Over the last two years, they have completed

75 projects (with 200 more project MOUs in place), 73 charging stations and over 1,000 solar lights.

As Jason shared his story, he repeatedly came back to four key messages:

1. Startups never look like their initial idea: The initial idea for a startup is a starting point. But it's getting out and talking to people that allows you to refine your idea and develop it into one that's really interesting. Through Jason's stories, it was evident that he spent a small amount of time declaring his plans and a far greater portion of time asking questions and listening to the answers. Through talking to stakeholders such as customers, investors, community members, mentors, manufacturers, politicians and engineers, you are able to discover a truly great idea.

2. Be familiar with tech trends and other innovations: Entrepreneurs need to be curious and read and research different technologies and theories. By spending time with the right people in the right places, you'll find avenues to bounce ideas around, combining different pieces of inspiration to create a truly valuable idea. Jason emphasized the need to "take a shower"—his version of taking a step back and letting the ideas mix and mature so that you can look at the big picture.

3. Make something people want: To be successful, you need to commercialize something that

people will actually pay for. By looking at what people are using now and which aspects are broken or not performing optimally, you can generate ideas. Not sure how to do this? Take a luxury and make it a commodity. Or redefine the problem, or make things cheaper or easier. And, if all else fails, build something that you want—there may be others with the same or similar desires.

4. Get married to your co-founder: Jason describes finding the right co-founder as being similar to that of finding a romantic partner: you'll be settling in for the long haul, so make sure it's the right person. A balance of skills is ideal, but above all, character and commitment are the most important.

The relationship is going to take effort, sometimes lots of it, and persistence and patience are key. Take the time to find the right person and

then make sure you're both dedicated to seeing things through to the end.

Solar energy continues to get cheaper, while diesel is increasingly challenging to affordably access and, in many places of the world, an electricity grid is many years away, if at all. Jason and SunFarmer have learned invaluable lessons through their first projects and the company's business model continues to evolve as the team finds better ways to provide reliable electricity to nations such as Nepal.

Jennifer Stoneburgh is Senior Associate at MaRS Cleantech Venture Services.

Jeffrey Asher

The 'Robin Hood' model: A sustainable product testing for developing countries

Today, there are cost and time pressures placed on all of us for much of human activity. Consumer product evaluations are no exception.

Over my 22 years as lab manager at Consumer Reports, the pressure to do things better and quicker was a continuing drumbeat to keep this famed, independent tester of U.S. consumer products growing. Moving from a print- to a Web-centric business quickened CR's pace and increased greatly the amount of information required for product testing and surveying. Most importantly, to meet these far higher productivity goals, CR needed to assess critically what was the essential information needed by the consumer to make their buying decision.

In 2012, I began consulting under the Massachusetts Institute of Technology's Comprehensive Initiative on Technology Evaluation, a research program funded by the U.S. Agency for International Development.

To date, together with MIT personnel, we have evaluated both portable solar lanterns in Uganda and water filters in Ahmedabad, India. These comparative consumer products results were published using a "CR-style" of ratings. Test methods and procedures were also developed in a manner similarly used at CR.

Not surprisingly, the issues of cost and the required time to publish were factors that needed to be addressed throughout these test programs.

Thus, the reason I believe this discussion topic needs to be addressed long-term if CR-style product evaluations are to succeed, be cost-effective and timely.

There are no easy answers. They are made more complex when one evaluates a consumer product in emerging countries where market intelligence is often hard to come by and the local marketplace can change quickly.

There is the option for looking locally in emerging countries for technical support to do this research. While this potentially solves some challenges, MIT found in Uganda that there are problems in finding sufficient, locally trained personnel who can be retained long-term.

Partnering with a "UL-like," local, standards organization could have potential. They already evaluate products against safety standards. By expanding their charter to include performance-based product assessments, more local jobs could be generated using their technically trained, sustainable and cost-effective workforce.

Crowdsourced data could provide product market intelligence locally without having "boots-on-the-ground." I am cautious about applying crowdsourced information to determine independent and accurate product performance factors. But there is undoubtedly a role for it with product reliability and defining which models are in the marketplace and for what price.

The 'Robin Hood' model

Crowdsourced data and the use of local standard testing labs can only go so far to develop a sustainable product testing lab for emerging countries. What is still required is a unifying force or overall management system to ensure its creation and long-term viability. Below is a novel approach that I believe could better ensure this sustainability objective.

This proposal marries together a number of groups, each with its own expertise. The concept would move consumer product testing for developing countries from an academically centered lab like MIT with a transient staff, to a full-fledged, sustainable business connected at the hip with academia for fulfilling research needs and ensuring commercial independence. It would also seek out opportunities locally in the developing countries to build technical expertise and new jobs.

The proposed elements of this laboratory structure include:

1. An already established global business like Underwriters Laboratories which would expand their business beyond standards testing to comparative, product performance evaluations.
2. MIT and other academic institutions would drive innovative research — product evaluation and survey research — directed at developing countries. Specifically, this focus could entail new test methods development and survey research including crowdsourcing initiatives.
3. Local expertise would be sought out from these targeted, developing countries for which products are evaluated. Technical field support for these product evaluations includes market intelligence by analyzing crowdsourced data; sourcing products from the marketplace for evaluation; and performing lab testing *in situ*. For instance, this concept would have provided solar lantern exposure testing in Uganda for comparison with the work done in Boston on MIT's campus.

"Robin Hood" enters this proposal by providing sustainable funding for academic research (item No. 2 above) and developing local resources (item

No. 3) using a small portion of the profits earned by the global business (item No. 1). This Robin Hood concept would provide a steady stream of profits from the commercial sector to support the commercially independent work for the developing world.

This business model also ensures that there is an appropriate infrastructure to deal with the orderly policy and procedure developments as well as good management practices. Finally, using this sustainable model will allow the creation and maintenance of sufficient, permanent laboratories fitted with state-of-the-art equipment and trained, permanent staff.

This multipurpose business entity will have a face toward both the developed and developing worlds. The sharing of some of the same staff, management and lab space will bring greater efficiency for its overall impact.

Using the unique expertise from commercial to academic to the local developing country, the following deliverables could be envisioned:

Comparative product testing focused on the marketplace of developing countries. Ongoing and timely local, competitive market analysis. Survey research to better understand the consumer use of the product globally. Content development for media use (free and for pay). Transformation into an incubator to better ensure that the most promising, affordable and innovative products find their way more quickly into the marketplace of developing countries.

With CITE's ongoing pioneering efforts to assist the consumers in emerging countries to make good buying decisions, these and other proposals should be evaluated and fine-tuned to develop a more sustainable, product evaluation business model.

Jeffrey Asher is MIT's Comprehensive Initiative on Technology Evaluation suitability adviser and consultant.

SciDev.Net

Foreign firms don't boost African tech skills

International businesses that set up shop in Sub-Saharan Africa employ a lower share of local skilled workers than domestic companies do, a study has shown.

This finding goes against the common presumption that multinationals bring professional skills and technical knowledge to their host country, says one of the study's authors Francesco Prota, an economist at the University of Bari Aldo Moro, Italy.

Governments in Sub-Saharan Africa should keep this in mind when they seek to attract foreign investors in the hope that these would create "better" jobs for locals, he adds.

The study, published in the *Journal of International Development* last month, analysed data collected in 19 African countries by the UN's Industrial Development Organisation (UNIDO) as part of its Africa Investor Survey 2010. Prota says his team's analysis is stronger than existing papers on this subject because it relies on data collected at firm level rather than at country level.

The authors find that multinational enterprises in Sub-Saharan Africa are less likely to employ skilled workers than domestic firms across different types of industry — including construction, extractive industries, heavy manufacturing, and light manufacturing, such as textile or chemical production.

Jostein Løhr Hauge, a PhD candidate in development economics at the University of Cambridge, United Kingdom, says his own study of a small sample of textile and footwear firms in Ethiopia

came up with similar findings. "Foreign firms who come to Sub-Saharan Africa are more productive in their use of modern technology, but prefer using a high ratio of unskilled labour. That's one of the reasons why they come to Africa — because labour is cheap," Hauge tells SciDev.Net. But, he adds, he has seen examples of Chinese and Turkish firms providing training programmes for local workers.

Prota's study found that foreign firms paid lower wages than domestic ones. Chinese firms in particular pay their skilled workers 23.7 per cent less than domestic firms do, and about 50 per cent less than European and US firms do. "Investors of Indian origin and those from other Sub-Saharan African countries pay higher wages to skilled workers [than local companies] but not to unskilled ones," the paper says.

"Some people say foreign firms are technologically advanced and employ people, so it's good" for host countries, Prota says. "Other people say foreign firms use resources and don't give anything back to developing countries. These are ideological positions. When you look at the data you see things are more complicated."

Not all jobs created by multinational firms are equal, so governments in developing countries should focus their efforts on attracting investments from sectors and countries that are more likely to generate better and higher-paid jobs, the study recommends.

For example, Hauge says, rather than attracting the extractive industry, agriculture or services, African economies need manufacturing to move

towards high-tech and more economically advanced industries.

To do this, policymakers need to have a good idea about their country's economic setup, Prota says. He says governments need to attract firms that are more advanced than those already established in the country, but not so distant in terms of technology that it would prevent them from building strong links with local companies and universities.

Ethiopia, for example, has set up institutes to provide training and research that matches the needs of businesses, such as the Leather Industry Development Institute, which aims to boost the development of the footwear industry while

providing an outlet for the country's abundant livestock products, says Hauge.

Governments can also ask foreign investors to start joint ventures with local organisations to make sure that innovation activities take place in the host country and result in transfer of technology, he adds.

SciDev.Net is a source of news, views and analysis on information about science and technology for global development.

Anne Miltenburg

Five mistakes that social entrepreneurs make when crafting their brands

As a brand developer, I've met countless social entrepreneurs all over the world: people with an extreme passion for social or environmental impact. They have a lot to master in order to make their ventures succeed – from setting up a production chain, to technology, HR, complex investment structures, and more.

Branding is yet another discipline to conquer, and though entrepreneurs see it as crucial, they often feel they lack the knowledge and skills to make it work for them. When entrepreneurs approach me, it is usually after having undertaken some form of branding on their own, and often they have run into difficulties.

Here are some common branding mistakes made by early-stage social entrepreneurs:

Mistake #1: Forgetting to build a solid value proposition into the brand, beyond social impact

Social entrepreneurs are often so passionate about their social and environmental impact that they forget to highlight the other value their product or service brings. This can be a risk when a competitor with the same impact goals comes along.

Whether you sell a solar-powered lamp, legal aid for all, or a piece of software, you need to be clear about the value of what you offer, and why a customer would choose your product over someone else's.

Is your solar lamp a cheap way to power devic-

es quickly while on the road, for example? That is the reason people will buy your product, talk about it, and gift it to others. For customers, the social and environmental impact may just be a big cherry on the cake.

Mistake #2: Asking for free creative work

Most entrepreneurs have a cousin or a friend who is a designer, and who is willing to do some work for them on a tiny budget. Unfortunately a design project based mostly on good will has several downsides.

It's hard to steer a creative process when the outcome is gifted to you, and it's hard to manage your own internal process and team input when there is no budget cap.

Then there is the risk of hidden interests. Behind pro bono work there is often an emotional expectation. You expect to get the design work that you want, while your pro bono designer might expect a lot of creative freedom. Make sure both parties open up about their motivations, so you can create a win-win situation.

Instead of pro bono work, consider alternatives. Ask yourself if you really don't have a budget, or if you are simply unwilling to allocate it at this early stage. You could find a designer whose work you respect, and build a long-term relationship where a small initial budget is offset by larger budgets down the line, or even a stake in the company. A strong relationship with a designer or

agency is a great asset for any new company.

Mistake #3: Picking a name without doing research

Naming is arguably the toughest part of the branding process. If a great name didn't magically pop into your head at the start of your endeavor, it can become a really tough process. Will you choose a functional name or create a novel word?

Do you love your name? Will your audience love it? Is it even legally available? The naming process is full of questions.

An entirely novel name will require more effort to load with meaning. A more functional name makes clear what it represents, but will be harder to protect and more difficult to differentiate from the competition.

Be wary of names that are too generic, hard to pronounce or spell, or have unfortunate alternate meanings in languages that are spoken in the markets where you are active.

Always check for the availability of domain names and social media handles. Also look at the names of competitors before making your choice. You don't want to do a forced rebrand under the threat of a lawsuit if you accidentally choose a name that is in use by someone else.

If you happen to choose poorly, there is one consolation: while a bad product cannot be saved by a great name alone, a good product will make people forget its awful name (iPad anyone?).

Developing brand names is a real art, so if you can't figure it out on your own, find a professional namer.

Mistake #4: Only looking at your primary customer as your brand's audience

A few years ago, I was asked by a maker space (an open workshop where people can work on electronics, woodworking, robotics and 3D printing) to do an analysis of their brand. They had just failed to secure the funds they needed for the next four years, and were desperate to find out why their funders did not see the value of their business.

Was there a leak in the brand, and could it be repaired? As we dug through all the touchpoints between their brand and their audiences, it became clear that they only communicated directly to the makers themselves. The organization never made an effort to reach the most important customer they had: the one that provided their funding.

Defining your brand's audience is crucial, and you can define it as broadly (e.g. the press) or as narrowly (e.g. that particular New York Times columnist) as you want. Being creative about designing the experiences they all have with your brand helps you develop better relationships.

Mistake #5: Expecting people to care

Your brand is done! You have your name, your messaging, and your visual identity; your website is up; your social media accounts are claimed, and... absolutely nothing happens.

The plain fact is that beyond your circle of friends, family, and partners, few people will care as much as you believe they should. The result is that you can hit a dip after launch.

Brand building is a marathon, not a sprint. Brand development should always be followed up by a good communication strategy: who do you need to reach, and how will you reach them? What do you offer them, and how do you want them to respond? Create a communication plan for marketing, advertising or PR throughout the year, based on your goals and your resources. People care, but we can't leave it to chance whether they take action.

It's time to arm yourself with a knowledge of branding to help move your social venture forward. Enjoy the process, see your business become a brand, and thrive.

Anne Miltenburg is a nomadic designer, brand developer and writer.

Tassos Stassopoulos

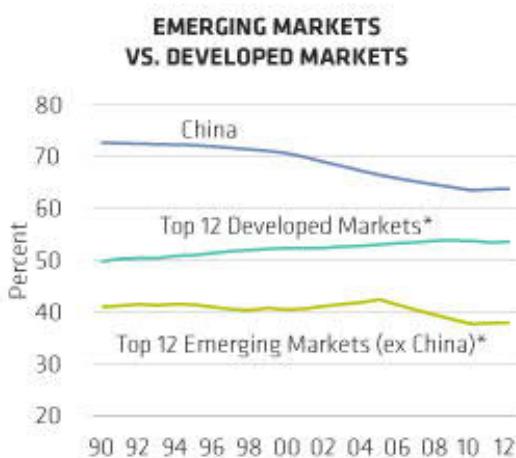
Power surge for women as emerging consumers

What's the connection between electricity and women? Electricity is an agent of empowerment, able to transform societies and economies in emerging markets. It paves the way to buying home appliances like electric cookers, refrigerators and washing machines, freeing up women from hours of daily housework. In our view, more access to power in developing countries will be a catalyst for more women to join the workforce, leading to huge changes in consumer spending patterns.

In developing countries, women's job opportunities have typically been limited. And with so many responsibilities in the home—and no household appliances to ease the burden—most women find working outside the home to be impossible. Less than 40% of all adult women in the 12 largest emerging markets (excluding China) participate in the labor force, according to the latest World Bank data available (Display).

WOMEN LEFT OUT OF EMERGING-MARKET JOBS

Female Workforce Participation Rate



Through December 31, 2012

Not much has changed over the past two decades either. Since 1990, the female workforce participation rate has stagnated in emerging markets, while it has increased in the developed world. In China, the female participation rate has dropped from the very high level maintained during the country's communist history. But this is an exception. In other countries, like India, there has been little change.

The Electric Disruptor

Electricity can make a difference. For example, we believe the Indian government's ambitions to significantly upgrade electricity supply across the country by 2019 could be a major impetus for change.

In South Africa, providing electricity led to a big boost in women entering the workforce. In areas that benefited from the electrification program, the female workforce participation rate jumped by 9.5 percentage points over five years through 2001, according to an academic study.(1) Translating this to India, if Prime Minister Narendra Modi's reported ambitious plan to connect 400 million people to power grids is successful, it could enable eight million women to enter the workforce by 2019, our analysis suggests (Display). But much will depend on whether enough power is provided to enable the typical family to run basic appliances.

WOMEN LEFT OUT OF EMERGING-MARKET JOBS

Female Workforce Participation Rate



Through December 31, 2012

Perhaps the most important benefit of electrification is refrigeration. For example, Smita, a 38-year-old working mother whom we met in Aurangabad, India, could save several hours a day if she had a refrigerator, since she then would no longer have to go to the market constantly in order to prepare fresh meals for her family. Indeed, our research into the use of over 150 refrigerators in

emerging markets found that the lower social classes use them primarily as time-saving devices in which to store their essential foods or prepared meals. This gives women the flexibility to work more hours and contribute to the overall family income, which in turn leads to women having a bigger say in how the family money is spent.(2)

Women Think Ahead

With more influence from women, family spending patterns should change. Academic studies show that women have a longer-term focus than men when it comes to financial decisions(3)—a finding that our grassroots research confirms. When family incomes increase, men tend to spend the extra money on short-term purchases such as consumer electronics or entertainment. Women tend to spend it on items with longer-term potential, such as education, savings and insurance products. So, as women gain more influence over household incomes, we expect spending in these areas to grow.

Joining the workforce could have dramatic knock-on effects. As more women gain a say in household finances, they're likely to strive to pull their families out of poverty, thereby helping to create a better-educated and more productive workforce. And many countries are ripe for change. In Indonesia, a third of the population—81 million people—don't have access to electricity; in Nigeria, half the population—76 million people—has no power.

These trends aren't usually on the radar of the typical investment fund. However, we believe that electricity is actually a powerful leading indicator and a great example of how disruptive forces can have unintended and far-reaching consequences. Private education, microfinance and insurance are just a few areas that could enjoy a burst of activi-

ty—and create investment opportunities. More broadly, we think investors should consider the many ways that female empowerment could affect economies, industries and companies, when looking to capture the potential of consumer spending across emerging markets.

References

- (1) Taryn Dinkelman, "The Effects of Rural Electrification on Employment: New Evidence from South Africa," *American Economic Review* 101, no. 7 (2011).
- (2) Siwan Anderson and Mukesh Eswaran, "What determines female autonomy? Evidence from Bangladesh," *Journal of Development Economics* 90, no. 2 (2009).
- (3) Nancy Qian, "Missing Women and the Price of Tea in China: The Effect of Sex-Specific Earnings on Sex Imbalance," *The Quarterly Journal of Economics* 123, no. 3 (2008). Nancy Luke and Kaivan Munshi, "Women as agents of change: Female income and mobility in India," *Journal of Development Economics* 94, no. 1 (2011).

Tassos Stassopoulos manages growth portfolios at AB and is the Global/International Research Growth Sector Head for the consumer sector.

Harald Schützeichel

A new support for solar entrepreneurs: Senda

The international Stiftung Solarenergie has started the "solar entrepreneur network for decentralized energy access" (Senda). Senda enables solar entrepreneurs to build their solar company and let it grow.

Independent Off-Grid Solar SME as the missing middle

The solar off-grid industry in Africa and Asia nowadays is mainly dominated by international manufacturers or distribution companies. However, the establishment of local solar companies, which work independently and are majority owned by domestic entrepreneurs, is important for sustainable job creation in the off-grid industry.

Small and medium enterprises (SME) are the main driver for innovation, poverty reduction, employment generation and social integration. The lack of small and medium enterprises (SME) in developing countries is a significant obstacle - commonly referred to as "the missing middle".

Double gap

Young solar companies face a double gap:

1. Early stage gap

- Lack of access to experience from other solar entrepreneurs
- Difficulties to get products due to the small order size these young companies have
- Not big enough to get support for business and management support
- Strong restrictions in accessing required capital:

"Wait-and-see" attitude of investors, no loans from local banks or only with unfavorable lending conditions.

2. Community gap

For young entrepreneurs it is very difficult to get information and exchange field experiences about business development, products, customer service, customer training, and reliable maintenance. The need for a customized mentoring and the opportunity to share experiences with other entrepreneurs is evident.

Senda provides a double solution

Senda closes the current double gap by building a bridge:

- Senda is focused on early stage companies and their special gap.
- Senda includes not just finance or technical assistance, but a strong long-term support as a network of like-minded entrepreneurs, coached and mentored by professional practitioners.

At the same time, Senda offers this service in a dual way, combining practical field work and projects with consuming and mentoring.

Proven concepts

Senda relies on proven concepts from the Stiftung Solarenergie, which have been implemented by this foundation in East Africa and Asia since 2004 to locally promote a solar craft:

- Establishment of solar villages for social impact, awareness creation and training
- Revolving Fund to finance products for end users
- Training for solar technicians in technology, management and finance

Sendea bundles the successful programs of the Foundation to a new, holistic and dual development program for young entrepreneurs.

Who can become a fellow of Sendea?

- Founder of solar companies, incorporated in a developing country of (East-)Africa or (South/East-)Asia
- Business approach:
 - Technology-agnostic: neither daughter company nor exclusive distributor of a manufacturer
 - Offer full power access for off-grid people through decentralized solar energy solutions
 - Follow a customer oriented approach: wide range of products, not just small plug&play
 - Ensure reliable after-sales-service and maintenance
- Personal requirements: CEO and/or founder with practical experience in solar energy technology

Benefits

As soon as the applicant successfully passes the application process, he starts with the "Blue Fellowship". Goal of the "Blue Fellowship" is to reach a stable situation for the company after latest two years. This stable status gives not only investors and suppliers confidence for cooperation, but also

the entrepreneur itself: he is in best way prepared to let the company grow. This makes the jobs at this company reliable.

A. Support in Practice

- Realisation of a solar village with around 100 households for awareness creation and training on the job
- Revolving Fund for end user finance
- Executive training (internship): 4-6 weeks of internship in an advanced solar company
- Field training for staff: Training at work through experts from solar companies

B. General support

- Executive mentoring over two years.
- Capacity building / Technical assistance / Business support
- Exchange with solar entrepreneurs (experience, knowledge)
- Eased access to products with better payment conditions
- Support for investment strategy and investor search

Start and information

Sendea started in September 2015. The first fellows are promising entrepreneurs in Uganda and Cambodia. More information: www.sendea.org.

Dr. Harald Schützeichel is founder of the Solar-Federation (www.solar-federation.org) and editor of Sun-Connect News.

Georgie Johnson

Three solar power projects where women are taking the lead

Forget international climate talks – women around the world are already taking the clean energy transition into their own hands in ways only women can.

Yesterday was the third ever 'gender day' at the UN climate talks in Paris, a day of gender-focused sessions that provides a platform for the often overlooked but massively important issue of how gender inequality is linked to climate change.

But whilst gender has certainly moved up the COP agenda in recent years, it remains a marginal issue. In more than two decades of negotiations, the UNFCCC has adopted just three decisions explicitly focused on gender-related issues – two of which were in the last three years.

Last year at COP20 in Lima, just 36% of delegates were women, and this year former UN human rights chief Mary Robinson has said that COP is still too male-dominated.

The link between gender and climate change is gradually becoming more widely known as climate change is increasingly understood in terms of human rights and social justice, but for those still in the dark, here are the two key things you have to know:

1. Women are differently affected by climate change due to their social and economic inequality (just as all marginalised groups are affected differently according to their inequality – including indigenous people, people of colour, and the global poor).

2. Women can offer incredibly powerful solutions to climate change – but they're consistently excluded from solution-making positions, from local government to international politics, despite their unique potential to help combat climate change

Their exclusion from conventional positions of power and decision-making is perhaps why women are so prevalent in grassroots movements and ground-level solutions to climate change – particularly in the global south.

Here are three current energy projects that are led by or focused on women, that illustrate the social, political and economic benefits of decentralised clean energy generation for the world's most vulnerable people – and for the climate.

These examples are all about solar power, but there are literally countless other ways that women are proving instrumental in both adapting to and mitigating climate change all over the world.

1. Solar sisters are doing it for themselves

Gender inequality (and women's greater vulnerability to the effects of climate change) is often directly linked to poverty, but studies show that the greater the proportion of a country's population that has access to electricity, the greater its gender equality, regardless of the amount living below the poverty line (\$1.25 a day).

Fossil fuel companies will use this kind of information to insist that cheap coal is vital to the

development of countries in the global south, but women-led social enterprise [Solar Sister](#) has an alternative plan – one that economically empowers women and doesn't involve burning the most polluting fossil fuel around.

Solar Sister aims to eradicate energy poverty by creating a deliberately woman-centered direct sales network that brings clean energy tech to some of the poorest and most remote communities in rural Africa.

Women buy solar lamps and clean cookstoves from other women to use and sell in their own communities, supplementing their income whilst giving them light to read and work by that doesn't involve inhaling toxic fumes.

2. Rooftop Indian grannies

This project is similar to Solar Sister, but it goes one step further along the intersectional scale, focusing on perhaps the most vulnerable type of woman – an old one.

In societies across the world, from remote rural villages in India to developed countries in the global north, women lose their social value as they age – no longer (conventionally) attractive or reproductive, they outgrow their use and are accordingly gradually sidelined.

The Barefoot College in Rajasthan trains older Indian women to become solar engineers, allowing them to challenge perceptions of their obsolescence, raising their social standing and influence in their communities.

Solar grannies, as they are known, demand respect for their specialist knowledge, and for bringing transformative access to light to their villages. Training older women is also a strategic choice.

Young men invariably leave their villages for work, and would take their knowledge with them, leaving the community without someone to maintain solar panels and lamps, and without someone to pass on their expertise to the next generation.

Old women are embedded in their communities, taking care of children and playing a key role in all domestic operations, including energy use.

The solar grannies, most of whom are illiterate, complete a six-month training course at the Barefoot College before returning to their homes armed with screwdrivers, batteries, circuit boards, lightbulbs and a new sense of (well-deserved) self-respect.

3. One woman who just had no time for that oil and gas business

This one is just a brilliantly simple bit of solar tech that's in use in sixteen countries on five continents, invented by Eden Full Goh, a young American woman who didn't feel comfortable being funnelled into the oil and gas sector as most of her fellow engineering students are expected to do – which makes sense, as polls show that women tend to care more about climate change than men do.

Instead she chose to build on an idea she had in high school – how to make solar panels track the sun efficiently. The product she ended up with uses bottles of water and gravity to slowly tilt the solar panel over the course of the day, which increases output by 30% without using any extra power. It also provides 4 litres of clean drinking water in the process, filtering the water out of the weights and into a receptacle ready for drinking.

Increased output means less solar panels, which saves people money and saves the energy it takes to make solar panels. People in impoverished off-grid areas often have to choose between spending their little income on energy or clean water – this way, they get both for less.

The gender imbalance in the energy industry is a big problem.

In the UK, more than two-thirds of the 100 biggest energy companies fail to count a single woman on their boards, and fossil fuels are the worst culprits: while women occupy 17% of board seats for power and renewables firms, the oil and gas sector manages a pathetic 7%. Is that because fewer women are interested in careers with businesses that directly contribute to planetary meltdown, or because the kind of people who run fossil fuel companies are also the kind of people who would only hire women as secretaries? Who knows.

Georgie Johnson is Social media editor at Greenpeace.

Daniel Tomlinson

Off-Grid solar firms should focus on customer experience, not just energy access

Companies working to bring solar to developing countries need to improve their service delivery if they want to attain disruptive levels of deployment.

Beyond-the-grid enterprises are raising more and more money, but moving from social impact to real venture capital investment will require them to step up their game. That means providing seamless service levels to some of the most price-sensitive, difficult-to-reach customers on earth -- akin to what people in developed countries would expect. It means bringing Apple-level service delivery to those who don't even have working toilets.

I believe our industry can achieve this. But we need to focus on what has driven success in consumer electronics: value, quality, access, seamless use and cheap financing.

Beyond-the-grid technologies like solar and LEDs face the same lofty expectations as any consumer electronic product. We need to meet those expectations.

The biggest hurdle is financing. Bringing a new product to market at the right price in a developing economy is daunting. Advances such as pay-as-you-go (PAYG) financing are an imperative for any manufacturer and service provider.

Still, within PAYG technologies, there are challenges like breakdowns in sending and receiving SMS payments, customers forgetting how to pay, and multi-step processes that can be challenging for some customers. Developing payment gate-

ways that are reliable, easy to use and product-agnostic will provide higher-quality user experiences.

The user experience needs to be consistent. A new energy customer develops a taste for more sophisticated and versatile uses almost immediately. Customers want products that can handle complex loads to power televisions, motors, radios, razors and coolers. They require systems that can handle these new loads, but are free of expensive service requirements.

"People need lights and mobile-phone charging, but what they want are televisions, radios and fridges," said Justin Guay, who leads the Sierra Club's international energy access program. "The space is already posting incredible growth rates fulfilling needs -- imagine when they fulfill what people want."

In order to build these services, energy providers must know what their customers want. Some startups, including BBOXX, have built product performance feedback systems that access individual customer details in a database. This allows the company to understand the energy usage, financing history and repayment discipline of each customer -- helping them better serve customers and model new markets. This type of basic data analysis allows companies to build new revenue models based on consumer credit and product insights. It also shows that leading startups are worthy of venture investment.

"The solar-utility model with long-term recurring revenues can build bigger, more valuable businesses than distributing lights for cash," according to Sandhya Hegde of Khosla Impact.

"The more information they have on customers, the better they can take away barriers to universal adoption: access to credit, length of warranty, response time for service, simplicity of usage. It's exciting for venture investors because it's exciting for the end customers," said Hegde.

The "energy-as-a-service" model blends all of these elements together. Under this model, the customer pays for performance and avoids the high upfront cost of buying a solar system. Off-Grid Electric, which recently brought in millions of dollars from SolarCity, has used this model in Tanzania to build customer loyalty and retention. It also helps Off-Grid Electric provide new system accessories and service offerings down the road -- an-

other reason why venture investors have been so interested in the firm.

Those are the elements that will build successful companies in the beyond-the-grid market: seam-less PAYG financing, data analysis of behavior, and energy service models that allow customers to avoid the upfront cost of energy systems.

The companies that focus on high-quality customer experiences -- not just basic energy access -- will be the most competitively placed to serve emerging markets.

Daniel Tomlinson is an access-to-energy entrepreneur and 2012 Echoing Green Fellow.

Simone Cipriani

Africa: the incubator of tomorrow

After having worked for years in Africa, I have come to believe it is one of the places in which the world of tomorrow is being incubated. Most of the stereotypes I had in mind 13 years ago when I began travelling across the continent proved to be wrong. What I discovered is that Africa produces innovation and desire for change. I believe four key factors are behind this.

Firstly, Africa is extremely young and female. Half of its 1 billion population is less than 21 years old. The UN predicts that by 2040 -- only a generation from now -- this population will reach 2 billion, out of which 70.1 percent will be under the age of 25 with women accounting for 57.7 percent of it. This young and dynamic generation wants a future. We have just witnessed protests that ousted a long term autocrat in Burkina Faso. My instinct tells me we will see more of such outbreaks. Why? Because these young Africans have a whole life in front of them and want to participate in their societies freely. Is Africa the place where democracy will be tested in the 21st century?

Secondly, Africa is connected. Mobile phones and networks are everywhere. While only 27 percent of population has access to the Internet (the world average is 42 percent), by 2019, data traffic in Africa is predicted to increase by 20 times. Not by chance, a lot of innovation comes from communications. It is in Kenya that I have seen such innovation for the first time: Mpesa, payments through mobile phones, which exist there since 2003! An-

other example: Econet, the telecommunication group created by the African entrepreneur (and great philanthropist) Steve Masiyiwa, who made online education available to all. Just think what this access means in terms of education, openness to the world and self-development opportunities... Is Africa the place that will make formal education obsolete?

Thirdly: Africa produces innovation out of necessity and limitations. African entrepreneurs often leapfrog traditional technological evolutions, adapting the technologies to their needs and finding innovative solutions for their use. Mpesa was created to transfer money among people with scarce access to formal banking and no credit cards. There are many other examples I've witnessed, such as 3D printers made from electronic waste dumped in Africa by the rest of the world, solutions for sanitation in absence of public sewage systems, software to translate the numerous languages used in the same country or region.

Africa is about innovation, but don't look for it in the well-known resource-based industry, which is mainly a recipe for conflict and corruption (see Tom Burgis' book, *The Looting Machine*). Innovation stems from today's real life challenges and finds solutions to core issues: sustainability, connectivity and affiliation. Africa has something to teach us here. Is Africa the place where innovation is adapted to the basic needs of people, and thus given a human face, in the 21st century?

I hear your question: "but what about pov-

erty?" Yes, poverty is still huge, and the numbers are increasing. One out of two Africans live on less than USD\$2 per day and 61.7 percent of the African urban population lives in slums. This represents about 570 million people...

Yet, we have the fourth factor: Africa tackles poverty through the informal sector, i.e. the part of the economy that functions without any formal business registration. It doesn't officially exist and it is often associated with illegal activities and tax evasion. However, in Africa it has another connotation as 75 percent of the work force of the continent operates in this sector.

I found the capacity to innovate and create small businesses that tackle extreme poverty is best represented in the informal sector. I've seen semi-formal cooperatives in Kenya (self-help groups), producing and/or selling goods and services in their local markets: shoes, food, garments, basic hardware and a mountain of recycled materials collected in dump sites or shipped to Africa by world charities. I've seen a shoemaker who works in a stall along a road with a small solar panel connected to a light bulb and an old stitching machine, able to put a new sole on second-hand shoes (com-

ing from Europe) to make them stronger to walk on the rugged terrain of slums. Of course, I have also seen a lot of misery and deprivation, but always coupled with the desire to get out of poverty through one's own work and efforts. I see dignity in this.

Yes, this may also mean exploitation or involvement in illegal activities, but the informal sector in Africa also proves the capacity to adapt and work in ways we would never consider. As such, Africa can supply many ideas on how to tackle extreme poverty that currently does not benefit from mainstream economic development. Is Africa the place where we can test new ways to re-define work and existence, allowing all of us to have a dignified life? Let us put aside our stereotyped visions of Africa and enable Africans to unleash all their potential for innovation. We may have something to learn from it.

Simone Cipriani is head and founder of the International Trade Centre's Ethical Fashion Initiative.

Evan Mills

Lifting the darkness on the price of light - the effect of fuel subsidies in the off-grid lighting market

Global subsidies to the energy sector impede entry of improved energy-using technologies

Thanks to widespread subsidies, the world is largely in the dark about the true cost of energy, including the price of light. Annual outlays for energy subsidies (to all fossil fuels and grid electricity) have reached nearly US\$2 trillion, approximately 2.5% of GDP or 8% of total government expenditures. Out of these, fossil fuels 'consumption' subsidies reached US\$523 globally in 2011, most of which in developing countries. Sub-Saharan Africa accounted for about 4 percent of global energy subsidies, 1.5 percent of regional GDP or 5.5 percent of total government revenues. The question of fuel subsidies is key to understanding dynamics in the off-grid lighting marketplace, and for formulating policy.

Energy subsidies compete with—and sometimes eclipse—public investment in other social programs such as healthcare and education. This is particularly pronounced in countries like Nigeria, where kerosene subsidies alone amount to more than those for security, critical infrastructure, human capital development, and land and food security combined.

While the primary intended role of subsidies in the developing world is poverty alleviation (in some cases the goal is to support energy-producing industries), they can also impede progress toward solutions that were not commercially available

when historical subsidies were established and that ultimately stand to more reliably reduce the costs of energy services for the poor. The report synthesizes and reviews existing information on the presence and interplay of energy subsidies and off-grid lighting in ECOWAS countries, explores unintended consequences, and the prospects for subsidy reform and associated policy strategies.

Subsidies for lighting fuels in the ECOWAS countries have doubled in the past decade to approximately \$4 billion per year, and these funds often do not reach the intended audiences

Official statistics are not available in most cases, but it is estimated in this report that current subsidies for kerosene are US\$4 billion per year in ECOWAS. About 180 million people as well as many businesses, schools, and clinics in the ECOWAS countries regularly rely on fuel-based lighting. This makes the average subsidy about \$20 per person each year. Many others who are grid-connected must periodically revert to fuel-based lighting during power outages.

There is a wide consensus about the inefficiencies and adverse impacts of energy subsidies. They often fail to reach the intended populations. The poorest 40% of the population typically receive only about one-third of the total subsidy for kerosene, the chief lighting fuel. This has the perverse effect of amplifying the very economic inequalities

that subsidies are intended to reduce. Smuggling or other efforts to obtain and resell subsidized kerosene at elevated prices often result in complete diversion of subsidy awards from any and all consumers.

Lighting fuel subsidies vary widely in ECOWAS, and impede entry of new and improved technologies that were not available when subsidies were originally introduced and lead to diversion of kerosene to transportation uses or dangerous adulteration (mixing) of kerosene with transport fuels

All energy subsidies lead to increased energy inefficiencies (a specific form of economic inefficiency), energy import dependency, hoarding, corruption, roadway congestion, and public health costs. A widespread example is where transportation fuel prices are suppressed through subsidization, stimulating an increase in fuel demand. Subsidies also represent a cost (often substantial) to governments, competing for limited resources with other development investment and social funding needs. Reforms to curtail subsidies are most vulnerable to collapse during spikes in world oil prices—precisely when they are most needed.

As a reflection of subsidy practices—present in all ECOWAS countries—kerosene prices vary by three- to four-fold. Moreover, these subsidies consistently position kerosene costs well below those of transportation fuels (as much as 65% lower).

This results in diversion of scarce lighting fuel to be mixed with transportation fuels, which in turn creates not only scarcity and black markets for lighting fuels but also increased vehicle pollution. Ironically, transportation fuel scarcity can also trigger diversion in the opposite direction, the adulteration (mixing) of lighting fuels with explosive transportation fuel, resulting in extensive burn injuries, house fires and loss of life. As of 2011, five ECOWAS countries had successfully reduced their kerosene subsidies so that they would not attain transport-fuel price ratios favorable to diversion or adulteration. The other ten ECOWAS countries, however, need to look more closely at the social and economic impact in their markets due to these subsidies.

Subsidies spent on operating kerosene lanterns could instead finance the purchase an LED replacement lantern

Under typical conditions, the annual cost of subsidizing the fuel consumed by a single kerosene lantern is equal to the cost of replacing that lantern with a solar alternative and thus eliminating need for fuel at any price.

Perversely, the presence of these subsidies increases the payback times of alternative technologies considerably. For example, a 50% subsidy effectively doubles the payback time for a US\$50 solar lamp from 6 months to 12 months. This differentially discourages the purchase of more costly (higher quality, more features) systems insofar as the user has to wait relatively longer to recoup their investment. For example, while a US\$10 system takes only 2 months longer to pay back under a 50% subsidy, a US\$100 system takes 20 months longer.

There is clearly a strong case for subsidy reform.

Fortunately, more efficient, equitable, and fiscally sustainable alternatives to conventional subsidy instruments are available to policymakers. However, kerosene subsidies are arguably the most difficult to reform in comparison to those applied to other forms of energy, and many efforts to do so in ECOWAS countries have been unsuccessful although there is overall movement towards closing the gap. Harmonizing subsidies across neighboring countries is a highly desirable, but is an even greater challenge than reforming subsidies at the level of an individual country.

While kerosene is the chief form of subsidized energy most used for lighting, policy analysis must consider a broader range of fuels and nuances. These include the relative pricing of transportation fuels. Similarly, any changes in kerosene subsidy will impact other end-uses for that fuel, notably cooking, and measures must be taken to proactively minimize any unintended consequences. Grid-electricity pricing and subsidies (including grid connection fees/subsidies) must also be considered, as this, too, is a backstop form of energy that will be compared to off-grid solutions powered by distributed generation systems.

Promoting a transition to LED lighting is perhaps the most effective ways of reducing dependence on lighting-fuel subsidies, but great caution should be exercised in shifting subsidy to these alternatives

There is wide agreement that the most effective approach to mitigating potential economic impacts of subsidy reform is to redirect those funds to well-targeted social programs, which can be far more efficient in terms of delivering support to those who need it most.

While it is clear that fuel-based lighting receives vastly more subsidy than solar alternatives, policymakers should exercise caution because, if done improperly, shifting subsidies to new lighting alternatives could inadvertently disrupt existing otherwise vibrant emerging markets. Other more nuanced options to support the market for energy efficient lighting include indirect efforts to remove market barriers to alternatives, improve financing, and relax import duties and other taxes on solar-powered lighting systems that meet specified min-

imum quality standards. Lowering import duties could be a very powerful instrument. Each million dollars of kerosene subsidy reduction could offset tariffs on about 250,000 solar lanterns, in the sense that the combination of these two policy actions would be revenue-neutral for the respective government.

Consumer costs of inefficient lighting strategies—even when subsidized—can be higher than those of more efficient and unsubsidized alternatives. In addition, the quality, quantity, and safety of the alternatives are far superior to the current status quo.

Evan Mills Ph.D. is Senior Scientist at Lawrence Berkeley National Laboratory, University of California.

Agnes Cho

How to meet the solar needs of the rural poor - 3 lessons learned

Recently, Global Partnerships and Solubrite, a solar distribution company in Nicaragua, worked together to organize a one-day workshop in Ocotal, a city in northern Nicaragua and home to GP's partner, FUNDENUSE. I attended the training to share with FUNDENUSE's credit officers what we at Global Partnerships have learned during our two years of experience of working in the off-grid lighting space in Latin America.

The purpose of the workshop was to train FUNDENUSE's credit officers in the technical aspects of solar products and share with them effective sales strategies to use when pitching them to their clients. Small solar lights and plug-and-play home systems are relatively new products to enter the market in Latin America. For the most part, they remain an unfamiliar technology to both the people living in off-grid communities as well as the credit officers that work with them. Facilitating this knowledge transfer and familiarizing the buyers and sellers of these solar products is integral to the development of this new sector in Latin America.

Observations from the training session

During the workshop, I led an exercise and had each credit officer in attendance write down several reasons why their clients do and do not want to buy a solar product.

Examples of reasons for solar

- To attain a higher standard of living
- Less harmful to your health
- To charge other electronics, such as a cell phone
- To save money
- Easy and practical to install and use
- To be able to work and study at night

Examples of reasons against solar

- Lack of ability to pay
- Limited capacity
- Lack of trust in quality and durability

Just from these several hours, we learned a few things about what drives demand for solar lights amongst poor, rural communities in Nicaragua.

1. Solar distributors should offer a range of products, from simple solar lamps to aspirational products like TVs.

- The first thing that rural customers want is a better light, and a solar lamp is as a cleaner and safer alternative to kerosene and candles. This is why we are supporting small light distribution, to build the early rungs of the energy ladder that enable rural families to begin climbing. And once they start climbing, people are interested in a solar product with additional functionality.

- Our experiences with Franco, one of FUNDENUSE's solar clients, clearly illustrates this

point. In his home, he has a Barefoot Connect 600, a small plug-and-play home system, which he uses to light up his house and charge his cell phone and portable DVD player. But not many people in his town in the mountains of northern Nicaragua can afford such a system. Understanding this constraint and yet wanting to spread solar technology in his community, Franco took out a loan to buy and resell five Sun King Mobiles, a solar lamp with phone charging capacity, to his friends and neighbors. Although his customers eventually want more lights and more solar power in their home, they all started with a smaller lamp. Solar distributors should be aware of this range of demand and capacity to pay and have the appropriate products available to offer their rural customers.

2. Poor customers want high-quality products

- Anecdotally, I've heard about how in Latin America, some people have had the misfortune of spending a lot to buy cheap products that broke down soon after. Whether this is true or not, people are wary of spending a lot of money on items that are "Made in China". In fact, I wish I had a cordoba for each time I heard during the workshop, "It's not a Chinese product."
- To address this, the Solubrite trainer emphasized a clear distinction between generic, poorly-designed products made in China and high-quality products designed by international companies that are manufactured in China. Solubrite also spent considerable time convincing the credit officers of the durability and quality of these lights. This goes to show how rural Nicaraguans are looking for the highest quality product that will not break down and those who sell solar lamps to the

BOP must be conscientious of the low confidence in the technology. Because even more so than the rest of us, the rural BOP cannot afford to purchase a cheap, flimsy product.

3. Seeing is believing

- During the workshop, credit officers explained that their job of promoting the solar lamps would be a lot easier if they could travel to the field with the lights and show, on the spot, the technology and product to their clients. This has to do with the relative novelty of solar lights. Credit officers want to give their clients the opportunity to see the light with their own eyes and feel it in their own hands. By doing so, they find that it is easier to interest and convince people of the benefits of solar energy.

Central to GP's thesis of investing in last-mile partners is their access to rural, off-grid communities. By contributing to the training of FUNDENUSE's credit officers, we ensure that the very people who are reaching these last-mile households are well educated about solar technology. It is also a great opportunity for us to learn from our partners' challenges and collective experiences to further the goal of expanding solar energy in Nicaragua.

Agnes Cho is program associate at Global Partnerships.

Lina M. Salazar Ortegón

10 things a company needs to know about the market at the base of the pyramid

Seventy percent of the population in Latin America and the Caribbean – more than 400 million people – live on less than \$10 a day. Even though their income is low, this segment of the population still demands goods and services, and represents a market of \$760 billion per year. Hundreds of pioneering companies see opportunities in this market to do profitable business while improving the quality of life of low-income people. But where should they start?

There aren't one-size-fits-all recipes for successfully serving those at the base of the pyramid (BOP). However, there are some basic principles that can help companies and entrepreneurs to understand the financial and social returns at the BOP. To learn more, participate in the IDB's BASE III Forum from June 29 to July 1 2015 at the Centro Banamex in Mexico City.

1. Don't start from scratch. Leverage existing capabilities. Aligning business opportunities with the company's existing capabilities and expectations can increase the likelihood of success when entering a BOP market. It not only allows companies to innovate and create business models that target low-income clients' real needs, but also generates the dynamics necessary to deal with the complexities of the BOP segment.

2. Creativity against risk. Serving a low-income market segment requires entrepreneurial spirit

and managerial willingness to innovate. Since innovating is equivalent to making mistakes, entering BOP markets demands patience. While it is impossible to eliminate risk, it can be minimized by sharing, or outsourcing it, or establishing alliances with other organizations that have the know-how or intelligence that the company lacks.

3. Alliances, alliances and more alliances. The best approach for meeting and overcoming obstacles to implementing business models at the BOP is establishing strategic and complimentary partnerships. They can help companies to overcome challenges related to distribution, access in remote areas, customer financing, the workforce, technical assistance and local brand recognition to name a few.

4. It's not a matter of margin. K. Prahalad, father of the term 'base of the pyramid', wrote that the BOP is not a "market that allows for the traditional pursuit of margins; instead, profits are driven by volume and capital efficiency. Margins are likely to be low, but unit sales can be extremely high." It is critical that BOP business models have massive impact or have the potential to be scalable.

5. More observation, less assumptions. It can be counterproductive to make assumptions about the needs and preferences of people at the BOP.

This segment is like any other commercial target. Behavioral economics and ethnography are useful tools for understanding behaviors and decision-making patterns in BOP markets. No product or service is going to be successful with low-income consumers in the long term unless companies understand what it is like to live on less than \$10 a day.

6. The economic return must be tangible. Unless they perceive that a good or service can provide tangible economic benefits, BOP families – and particularly those family members who make the spending decisions – will not purchase them. Therefore, it is important to carefully consider how the product or service is offered and how the benefits are being promoted.

7. It's not just about low prices. For low-income communities, a cheap product or service may not be enough of an incentive to make a purchase. It is imperative that they feel they are getting the best quality for their money. Building a relationship of trust with consumers and minimizing the perception of risk is crucial.

8. The BOP market is not a monolithic block. Not all of the more than 400 million people at the BOP have the same income. Within this base, the segment of those earning between \$4 and \$10 is quite large. Family income and the budget available for discretionary expenses determine how low-income consumers prioritize their spending and give hints on the factors that influence their purchasing decisions.

9. The BOP is not static. Between 2000 and 2010, significant economic growth in Latin America and the Caribbean benefited BOP people. Millions overcame poverty and the segment earning between \$4 and \$10 grew considerably. As a result, millions of low-income people are now beginning to prioritize their spending on education and health. While this segment is not always predictable, it has transformed in the last decade and is likely to continue evolving and presenting new challenges to those who serve it.

10. The power of connectivity. Today, more than 90 percent of the BOP people in Latin America own a mobile phone. On average, they use it seven times a day. Most of them are standard phones, revealing the huge potential market for low-cost smartphones. The field of action is very broad, and developers could achieve much greater market penetration if broadband was enhanced in Latin American countries. The combination of broadband access and smartphones or tablets could trigger hundreds of applications related to healthcare, financial services and agriculture.

Lina Salazar Ortegón works for Opportunities for the Majority (OMJ) at the Inter-American Development Bank since January 2012.

Tom Jackson

Africa's new breed of solar energy entrepreneurs

African economies may be booming, but continued growth and quality of life are being jeopardised by lack of power.

The International Energy Agency (IEA) estimates 585 million people in sub-Saharan Africa lack access to electricity, with the electrification rate as low as 14.2% in rural areas.

The problem is most acute in East Africa, where only 23% of Kenyans; 10.8% of Rwandans; and 14.8% of Tanzanians have access to an electricity supply, according to the World Bank.

In spite of efforts to get people onto the grid, population growth has meant these figures stay fairly steady, with the majority of people still using costly and unhealthy forms of energy for cooking and lighting.

A number of companies and organisations on the continent have identified solar power as the solution. And a new breed of "solarpreneurs" is emerging, increasing access to power and generating revenues at the same time.

Modular living

"Solar is a valuable source of distributed energy," says Sachi DeCou, co-founder of Juabar, a company operating a network of solar charging kiosks in Tanzania.

"In many places in sub-Saharan Africa, populations are quite dispersed. Solar is modular so it can be sized to fit the needs of anywhere, from a light to a business, household to an entire village."

In agreement is Jesse Moore, managing director at M-Kopa Solar, which provides "pay-as-you-

go" renewable energy for off-grid households in Kenya, Uganda and Tanzania.

Off-grid households in East Africa, which also are largely low-income households, spend about \$0.50-\$0.60 (33p-40p) per day on kerosene lighting and basic charging costs, he says.

"With more than 20 million homes off the grid, this means over \$3bn (£2bn) is spent each year on these inefficient and unsafe energy substitutes."

Given the inefficiencies and high costs associated with alternative power sources, solar has proven hugely popular in places where it has been available.

M-Kopa Solar provides power to more than 300,000 households in East Africa for \$0.45 per day, and is adding over 4,000 homes each week. And with this increased uptake comes economic opportunities for the companies that provide it.

M-Kopa Solar's revenues are nearing \$20m per year, and the company is starting to licence its technology in other markets, such as Ghana.

"M-Kopa is demonstrating that off-grid energy will be as revolutionary to Africa in the coming decades as mobile telecommunications have been in recent years. Solar is a massive opportunity for entrepreneurs and investors alike," Mr Moore says.

Build a business

Other business models are seeking to allow ordinary African individuals to start their own solar businesses.

Ms DeCou's Juabar, for example, builds and op-

erates a network of solar charging kiosks in Tanzania which it leases to entrepreneurs, who then offer electricity services to their communities.

Juabar's entrepreneurs are currently earning profits of between \$75 and \$150 per month, with the company currently leasing out 30 kiosks to Tanzanians and looking to raise \$15,000 through crowdfunding in order to increase that number to 50.

"There has been a lot of development in the pay-as-you-go solar space over the past few years, facilitating access by reducing the upfront costs of purchasing a solar system," Ms DeCou says.

"As we continue to make solar technology more widely available and affordable, one of the most exciting areas of opportunity becomes what you can do with this solar electricity.

"Solar is a source of reliable, accessible electricity. Once you can develop that access you have the opportunity to develop new ways to use that electricity to meet community needs. That is what I get most excited about."

Henri Nyakarundi is employing a similar model in Rwanda. His company has developed a mobile solar charging kiosk.

The kiosks are operated under a franchise model, offering Rwandans the chance to run income-generating businesses by providing services such as charging of electronics and sales of electronic vouchers.

Wi-fi hotspots will be available from the kiosks soon - there are already 24 up and running with another 100 due this year.

Mr Nyakarundi says he plans to offer a single distribution channel for different products, services and content, while providing opportunities for entrepreneurship through a low-cost franchise model.

He believes the opportunities to create solar businesses in Africa are "huge", but as yet, they only exist at the micro level. The next step, he believes, is to move to the macro level - producing power for the grid through solar.

"However macro level requires large investment and unfortunately local banks are still not willing to finance such projects unless you are a big company," Mr Nyakarundi says.

Ms DeCou and Mr Moore cite different issues, with the Juabar co-founder saying there was a lack of adequate data on population density in the areas where the company works.

"We do our own research to determine ideal places for expansion, as there is limited access to reliable maps of population distribution," she says.

Mr Moore says the main obstacle to the growth of solar in Africa is the unaffordability of purchasing solar power "up front" for consumers, though he believes M-Kopa Solar has been so successful to date because it addresses the affordability barrier head on.

Governments see the light

As the likes of Ms DeCou, Mr Moore and Mr Nyakarundi look to boost access to solar and the entrepreneurial opportunities associated with it, assistance has been on hand from east African governments.

Ms DeCou commends the Tanzanian government for not charging Value Added Tax (VAT) on solar products, which she says is a great support to the industry and helps to increase access.

"Beyond that, there are specific government programmes to help facilitate rural energy access," she adds.

"East African countries offer VAT exemption on all solar products, which is a big saving for a small company like ours," Mr Nyakarundi says.

"It will be great to see an east African R&D [research and development] fund for local entrepreneurs that wants to develop new innovative technology to solve our local challenges, so we can stop just importing foreign technology - which most of the time is not designed for the African market - and create a new industry that can level the playing field between Africa and the rest of the world."

Tom Jackson is an Africa-based technology, energy and business reporter and co-founder of Disrupt Africa.

Finance

Justin Guay

The world's first securitization of Off-Grid solar assets

Pay-as-you-go solar firm BBOXX said it plans to lead the first-ever securitization of off-grid assets. The plan is to lower its cost of capital as it scales in developing countries.

Despite improvements in business and financial model innovation in off-grid deployment, investment has been painstakingly slow to materialize. That's because the enterprises working in developing countries face a trifecta of risk: impoverished customers, emerging markets and new technology models.

In order to solve this problem, BBOXX -- and other similar companies -- need to prove their case. Accurate information (i.e., credit analytics) demonstrates to risk-averse investors that customers will pay for their solar electricity in a predictable fashion that will generate financial returns for investors.

Data is something this industry is particularly well-suited to provide. Many of the leading companies providing solar to off-grid households and businesses rely on sophisticated pay-as-you-go technologies that leverage mobile money and communications platforms. Both platforms generate enormous amounts of data, which, if properly compiled and analyzed, can help financial institutions deal with risk.

BBOXX is using the 12 years of data it has collected to structure asset-backed notes that it plans to sell to investors. The notes -- called Distributed Energy Asset Receivables, or DEARs -- represent a bundle of customer contracts, with an average net present value of \$300.

BBOXX transfers this \$300 contract to a special

purpose vehicle (SPV) and collects a payment of \$210 in return. If BBOXX's installed cost per system is less than \$210, it will have immediately recovered all of its costs and some of its profit.

The DEARs pool of securitized assets consists of 2,400 customers with a low likelihood of default, based primarily on repayment history. Going forward, BBOXX will apply more sophisticated data analysis to de-risk these small pools of assets.

The DEARs structure convinced Dutch-based investor Oikocredit to buy the first issuance for a total value of 52 million Kenyan shillings (\$508,000). BBOXX plans a second placement for March of 2016 worth 250 million Kenyan shillings (~\$2.4 million).

The second DEARs transaction will be rated by a Kenyan registered credit rating agency. BBOXX, Oikocredit and financial advisor Persistent Energy Capital created this structure as a scalable funding tool for BBOXX. The company is aiming to finance the equivalent of \$16 million in 2016, both in dollars and local African currencies.

"This is the only financial structure that can scale to billions," said Mansoor Hamayun, CEO of BBOXX. "The fact that we can securitize the credit risk of the unbanked and, very soon, get rated, has us very excited. We now have a methodology to bring solar electricity to off-grid customers at a larger scale."

This financial inclusion is what makes distributed solar energy an incredibly powerful development tool -- one many in the financial inclusion community are only now beginning to recognize.

"We are thrilled to have helped put this tool of

modern global markets to work to finance off-grid solar energy companies. We believe that DEARs will bring in new global and local institutional investors as DEARs note financiers and that this will propel the growth of these companies to reach the millions of customers who want affordable clean energy that can bring them the modern services of lights, TVs, radios, refrigerators and much, much more," said Chris Aidun, the CEO of Persistent Energy Capital.

Justin Guay is a program officer at the Packard Foundation working on energy and climate issues.

Daniel Tomlinson

Can conservative institutions become the most innovative forces beyond the grid?

Family foundations, family offices and other non-traditional investors haven't branched out much over the years when it comes to philanthropy and grant-making. But that may be changing.

With a host of foundations exploring new innovative approaches to grant-making and program-related investments (PRIs), these sleepy institutions may be poised to unlock cleantech in frontier markets.

Just this week, the White House held an energy access event that served as a platform to announce investments. A few of these investments stick out as an innovative approach that others in this space may be exploring. The David and Lucile Packard Foundation's use of philanthropic tools to support \$15 million in projects is an example of the potential for impact-driven investors to unlock much greater amounts of capital over time to combat energy poverty and climate change.

As the Packard Foundation explained as part of the White House briefing, "These investments in distributed solar through Simpa Networks, SunFunder, and Off-Grid Electric assist in providing clean electricity for low-income communities and constitute a portion of a larger commitment to increase climate and energy investments. Ultimately, these investments address both the urgency of mitigating climate change and achieving life-changing development outcomes."

The Packard Foundation's innovative use of

program-related investments (PRIs), using a carve-out from the foundation's endowment to make programmatically driven investments with some financial returns, has provided much-needed debt that beyond-the-grid enterprises have been demanding for years.

According to Susan Phinney Silver, who directs Packard's PRI program, the organization is "focused on growing promising enterprises and business models that can create meaningful impact for clean energy access markets." Early-stage companies were selected that otherwise would not qualify for debt in a commercial marketplace, and Packard's PRI financing helps prove out risk concerns so that the companies might qualify in the future for commercial loans and other mainstream private capital.

Investing in clean energy solutions is something other family foundations are considering, and it could play a pivotal role in developing and de-risking the use of syndicated loan structures through PRIs to meet the growth capital needs of beyond-the-grid enterprises.

The use of PRIs to unlock debt for beyond-the-grid enterprises shows how family foundations can move out of a role dominated by less-catalytic contributions such as technical assistance grants and instead move into catalytic investments investing directly into enterprises.

But if foundations do not have PRI facilities, all is not lost. Using foundation grants to take the

first-loss position in a debt structure can prove equally valuable for unlocking debt by de-risking the lending opportunity for private lenders and commercial banks to come onboard.

That's important because family foundations can better utilize PRIs and first-loss positions to unlock the tremendous growth capital demands of the beyond the grid industry. One of the more easily rectifiable problems facing the industry is the shortage of debt capital, resolved by encouraging lending institutions to work together in syndicate to spread risk across multiple balance sheets.

Yet, this seemingly obvious solution is stuck as many lenders seek to monopolize deals exclusively while holding high-risk perceptions of the market. However, deals like those the Packard Foundation announced today show the power of collaboration with other lenders -- leveraging their flexible investment capital with catalytic grants to encourage the private sector and other DFIs to come to the table.

Indeed, there are several family foundations, family offices and other non-traditional investors currently exploring this space. If even a handful of these institutions set aside \$40 million to \$50 million collectively for PRIs and first loss, it could unlock growth capital for beyond-the-grid enterprises that could propel this market forward for decades to come.

These lessons and others will be captured in a working paper on best practices for investing beyond the grid, set for release later this year. What's

clear is that beyond-the-grid organizations require more longitudinal data on lending performance with a focus on consumer financing through pay-as-you-go business models. The vision pertains to how larger loan sizes perform across nuanced business models over time with emphasis on consumer financing tenors.

Creating a lending fund with an intentionally revised investment thesis that allows for higher-risk loans would serve as a breakthrough innovation, decreasing future lending error rates and increasing portfolio performance for future deals -- a pinnacle data set for private lenders to get into the game. Family foundations using PRIs and first loss as key tools may be the ticket to graduate lenders from discussions and catalyze capital for beyond-the-grid enterprises.

The Packard Foundation, along with other collaborators, has demonstrated today that financial innovation can come from unlikely places. Now it's important that this demonstration be replicated by the dozens of other foundations that could collectively move this market and end energy poverty beyond the grid once and for all.

Daniel Tomlinson is an access-to-energy entrepreneur and 2012 Echoing Green Fellow.

Harald Schützeichel

The underestimated challenge of PAYG (Pay-As-You-Go)

On March 18th, 2005, the first solar home system with PAYG technology was installed in Sub-Saharan Africa: in Kechemober, an Ethiopian village, 200km north of the capital Addis Ababa. Back then the Stiftung Solarenergie - Solar Energy Foundation equipped an entire village with solar home systems. Payment for maintenance and service was monitored and managed by means of a payment charge controller.

At that time, the payment technology was largely unknown and was widely ridiculed. Today more and more companies rely on this technology to provide loans to their customers: from Sun-Transfer, through Fenix and Bboxx to M-Kopa. And a catchy name was invented: Pay-as-you-go (PAYG).

The promising principle of retail loans has now at last received the attention that was missing for long. More and more distribution companies in developing countries are convinced that the granting of loans to pay for solar home systems, is an important way to offer off-grid households a comprehensive power supply.

This is undoubtedly true. But PAYG is also the crowning discipline of rural electrification and is underestimated by most.

Financial product in combination with a technical product

Some companies imagine PAYG as a solar system of the plug and play category: easy to use, simple to operate with little service and support costs. The reality is different: end customer loans

are a complex financial product that is offered in addition to a technical product (SHS).

For the distribution and management of a financial product, you need different skills than the ones an off-grid solar technician usually has. Here knowledge in the field of lending in micro-credit organizations are needed:

- What are the costs for the introduction of the PAYG system, including the training of employees in credit management? Then this related expense is as a rule greatly underestimated. Here it is important to train especially the consciousness of a good after-sales customer support.
- How to determine whether a customer is creditworthy or not? Especially when a customer does not have a monthly salary statement and no bank account, which is why the check of credit ability must be done by other means.
- Mutual rights and responsibilities - installation and maintenance of a solar system, on the one hand, and prompt repayment, on the other - must be established in a written contract. The contract must also contain possible sanctions for non-fulfillment of terms (for both parties).
- Even more important than contracts are social and moral obligations. Contracts made with customers in remote regions are difficult to legally enforce. It is thus crucial to clarify to customers, the social and moral obligations that they are entering into. Guarantors within the customer's personal environment can also provide support, for example, informing the neighbors works as a form of social control. Customers must understand that

their non-compliance with the contract will be known by third parties.

- Which procedure should be implemented to motivate or even punish defaulters? The PAYG technology only makes sure that the SHS won't provide power anymore. This does not yet clarify how customers can be motivated to continue. In the worst case the customer has bridged the PAYG technology and uses the SHS happily. Therefore, very concrete dunning processes must be trained and periodically reviewed.

- Which management of the payment by installments should be used in one's own accounting? Currently, each manufacturer of PAYG systems has its own management system. Whatever one chooses: the administration of payments has to be cleanly and reliably integrated into the financial accounting of the own company. Administration and professional supervision of tens of thousands of customers cannot be managed by long-hand or excel lists. Credit management should be supported by an appropriate Management-

Information-System, such as M-Solar. This includes a professional cash management, to ensure the liquidity of the own company. The more credit customers a company has, the more complex the customer and cash management will be.

When a company opts for this distribution channel with payment by installments, all these requirements for a safe and professional handling of the hire purchase need to be considered. PAYG offers great potential for rural electrification - provided that the implementation is carried out just as professionally and carefully as the installation of the related solar home system.

Dr. Harald Schützeichel is founder of the Solar-Federation (www.solar-federation.org) and editor of Sun-Connect News.

Ian Potter

Getting the big money into social impact

Institutional investors are increasingly interested in putting their money into social impact, but a gap remains between them and the people on the ground.

Scale has always been a challenge for impact investors. Both users and providers of capital suffer from size issues: The kinds of problems being solved on the ground, while noble and lucrative, don't always have the absorptive capacity to allow investors to deploy meaningful amounts of capital; and similarly, the capital is not always available in appropriate amounts. This isn't entirely because institutional capital owners aren't interested. It's often the case that the plumbing or delivery mechanisms for capital to flow between sources and needs is immature. As a result, many gatekeepers in the financial architecture remain sceptical, including family office managers and private bankers.

Scale is also an issue for investors who don't yet have sufficient expertise or the resources to achieve sustainable growth in the impact space. Many impact funds have bubbled up in the last five years, but the economics are challenging for them. Diligence costs can be much higher as a percentage of the initial investment than a LBO-type firm pays when putting money into a distressed company. While socially beneficial investments can achieve high or market rates of return, in many cases, the investments are found in parts of the world that are volatile and foundational elements like property rights or accounting standards are uncertain at best.

But optimism is growing that the pipes are lining up, for two reasons. First, serious institutional capital is starting to steer away from investments that have high environmental, social or governance risks. At the recent Triple Bottom Line Investing (TBLI) Conference at INSEAD's Asia campus in Singapore, Michael Salvatico, Vice President of MSCI Inc. cited a recent 2 billion euro investment by two European pension funds into low carbon investments under the MSCI Global Low Carbon Leaders Index.

"There are large amounts of money that are shifting away from climate risk investments and it's happening very quickly, we're just at the beginning," Salvatico told a panel discussion.

Secondly, major private banks and wealth managers are waking up to clients who are increasingly demanding impact investment options. "When we get to the next generation, they want to recycle, they want to divest out of fossil fuels. We're talking about a next gen that is going to drive this for all of us. It won't just be a philanthropic endeavor," said Bonny Landers an advisor and independent consultant to family offices in Hong Kong.

Bridging the gap

But amid the optimism, there is a palpable sense of frustration from those engaged in social projects about this unfinished plumbing and how they can unlock the capital that's supposedly "shifting" into responsible places. Bernard Fung, head of family office services at Credit Suisse summed this up well: "Looking at capital flows and

the amount of money around this, I think we are in early days in terms of significant capital to an area that is loosely defined as impact investing.

The dominant sources of capital going into impact investing are currently motivated investors, family offices, endowments and development finance institutions. This makes it easy for projects to get quick backing and decisions on financing but this is not where the scale is.

To get the money across the gulf from major institutions, two things need to happen. First, institutions and fund managers must be reassured and convinced that impact is an investable sector or style and not a charity exercise. This was reflected in the sentiment at the TBLI conference, with more than one call to do away with the name "impact investing" as all too often, private sector institutions think it is either an expensive low-return exercise or a CSR one. Impact promoters should understand that fiduciary fund managers have to earn a return on the risk they're taking and any pitch for investment should include this conversation. While family offices can be convinced on the basis of philanthropic impact, institutional investors must be convinced of the financial returns in addition to the social impact.

Secondly, consolidation may be a logical step for independent private equity general partners (GPs). While some impact funds are raising second funds after successfully exits in their first with good returns, a logical next step for the industry could be to consolidate impact funds into other platforms, becoming part of an asset management platform like Carlyle or KKR. This could serve to bring costs down and drive scale and reputation.

The chicken and egg situation

While the big money is waiting for scalable opportunities to appear, the big opportunities are

waiting for the big money to arrive. Encouraging stories are starting to emerge which could tip the scales. While Salvatico's example may be of money shifting into listed equities, it could be considered a logical first step for major institutional money to start looking at investments through an environmental, social and governance (ESG) lens.

Some social enterprises are receiving big investments on their own merit. En Lee, head of Asia Pacific at global impact investor, LGT Venture Philanthropy (LGT VP), cited an investment LGT VP made in M-KOPA Solar, an innovative asset financing company that provides solar home systems to off-grid households in Kenya and other countries in Africa using an affordable mobile money payment plan. Since its commercial launch in October 2012, M-KOPA has connected more than 200,000 households, and is now adding over 500 new homes each day. LGT VP just made its biggest investment yet in the company's fourth round of investment, leading a US\$12.5 million debt and equity deal. This follows M-KOPA's last round where it raised US\$20 million from Commercial Bank of Africa, Bill & Melinda Gates Foundation, LGT VP, Imprint Capital and Netri Foundation. "There are large players validating this and there will be more to come" En Lee said.

M-KOPA serves as a good example of an organisation able to demonstrate an ability to effectively tackle social and environmental problems, while providing its investors with a viable financial opportunity.

Ian Potter is an INSEAD Distinguished Fellow with INSEAD's Global Private Equity Initiative (GPEI).

Andrew Blyth

How crowdfunding might secure energy access

Energy poverty is a critical issue afflicting a billion people every day in developing countries where creative thinking and disruptive solutions could be the only but also the best responses. Countless communities are regularly plunged into darkness through weak power grids and the mismanagement of state-owned enterprise. Despite promising signs of economic expansion in some of these places, prospects for real change are stunted economic growth and a growing frustration of being left behind the rest of the world.

While much was made of the Prime Minister's allegedly indifferent performance at last year's G20 summit, the Australian media largely ignored his success in securing a global political commitment for more inclusive energy institutions, strengthening of energy markets, enhancing energy security, phasing out of inefficient fossil fuel subsidies, and generating support for sustainable growth and development. These landmark goals are encouraging but the challenge is improving energy access which requires what some commentators are calling a 'disruptive approach' to finance, technology and customer engagement.

How big is the problem, really? Globally, there is close to 1.5 billion people lacking access to electricity and nearly 3 billion people in rural areas of Asia and sub-Saharan Africa deprived of modern cooking energy options. The World Health Organisation (WHO) estimates that indoor air pollution caused by inefficient and inadequate cooking methods is responsible for some 1.5 million pre-

ature deaths per year, mostly women and children. With conventional approaches having approached technical, environmental and even social limits, a "revolution" in business models, technologies and policies supporting energy access is urgently needed.

The International Energy Agency (IEA) estimates the cost of providing universal energy access by 2030 will require annual investment of US\$48 billion per year with much of the infrastructure required in sub-Saharan Africa. The IEA explains that some US\$18 billion annually needs to be sourced from multilateral and bilateral development sources, US\$15 billion from the governments of developing countries, and US\$15 billion from the private sector. While the share of the global population lacking access to energy is projected to decline to 12 per cent by 2030, a billion people will still lack access to power emphasising the need for new thinking in the provision of energy.

The task of rural electrification is daunting and, given the limited public finance available in a post-GFC climate, greater effort is needed to engage the private sector in developing innovative forms of finance to devise new energy technologies for energy access, similar to the approaches being trialled to accelerate mobile phone coverage in developing countries. The current barriers to increasing private sector finance include the high costs of supplying rural area households, lack of appropriate financial incentives, weak implementing capacity and power generation shortage caused by government inaction and lack of infra-

structure investment. A recent report by Bhattacharjee (2015) into rural solar lessons in Nicaragua highlights that solar is the preferred technological solution to electrifying rural villages and lessons learnt from rural off-grid solar customers can be applied elsewhere.

The key to success appears to be managing consumer expectations. It is apparent that small-scale solar home lighting and charging systems enjoy growing demand; they have cultivated an aspirational value; and most consumers are aware of improved indoor health conditions and ability to power mobile phones and radios. The report also notes the challenges arising from an inability of customers to pay, limited off-grid solar products, performance reliability, and meeting customer expectations.

One possible creative solution to disrupt traditional financing of rural electrification is crowd-sourced funding for off-grid solar. Crowd-sourced funding has shown its capacity in recent years with platforms such as IndieGoGo, Kickstarter, Rockethub and Pozible becoming increasingly accessible through the Internet. Crowdfunding has rapidly become a valuable alternative source of funding for entrepreneurs seeking external financing in various forms including equity-based, profit-sharing, lending, and donations. It is most often associated with community-based experiences that generate "community benefits" for participants while helping entrepreneurs to adopt new approaches to entrepreneurial projects and manag-

ing ventures. The scope offered by crowdsourcing leads in turn to new forms of business development in which the "ordinary" crowd gets more closely involved as active consumers, investors or both. Although the primary goal of crowdfunding is to raise money it also serves to test, promote and market products, to gain a better knowledge of consumers' tastes and create new products or services.

Early analysis suggests that disruptive finance tools such as crowdfunding are capable of accelerating the deployment of off-grid solar where traditional finance mechanisms have failed. With the right governance structures and oversight of this nascent finance tool, it is easy to imagine the good that could come from the "crowd" investing in off-grid solar in villages in rural areas of Asia and sub-Saharan Africa. While crowdfunding is an imperfect tool the potential for abuse should not prevent global leaders from promoting this bold concept given what is at stake: improving power coverage and potentially lifting a billion people out of poverty. Global leaders have committed to energy access; they now must deliver as the world is watching and wants to be involved.

Andrew Blyth is adjunct lecturer, University of NSW Canberra at ADFA

William Burckart

Impact investing needs a better way to measure impact

In places where electricity is scarce or unreliable, kerosene lamps are a standard lighting source—but the fumes from burning kerosene pollute the air and kill 1.6 million people each year. D.Light Design, a private company based in San Francisco, manufactures inexpensive solar-powered lamps and sells them cheaply around the world. It is safe, reliable, and renewable energy available for about the same cost as a few candles. D.Light believes that it's not only reducing pollution, but also improving health, safety, and performance—in school, productivity, and income.

This is a perfect example of an impact investment: the company is turning a profit while meeting a social need in an environmentally-sustainable way. And with support from firms like BlackRock, Merrill Lynch, and Bain, impact investing is no longer a fringe movement.

Yet it also sits on the cusp of mainstream wealth management, because we haven't done a good enough job of demonstrating impact. D.Light, for example, can easily report how many lamps were sold (over 9 million), but capturing the wider impacts on health, education, and the economy is more challenging. Without hard numbers to offer investors and their advisors, impact investing is a tougher sell. Better tools exist; if we used them, impact investing could, well, make more of an impact.

Surveys consistently show that Gen Xers and Millennials rank what their investment will do over how much they'll make. They want to be more involved in their investments than the old charita-

ble giving model of "making money and giving back" (personified by Bill Gates and Warren Buffett) allows. They want their investments and philanthropy to be nearly indistinguishable.

Financial managers are the gatekeepers to impact investments, yet our research shows that they don't really understand what it is, won't bring it up to their clients, and don't place any value on learning more about it.

Even managers who are aware of impact investments are wary to suggest them, for lack of metrics. In a new report released by the Money Management Institute entitled "Bringing Impact Investing Down to Earth: Insights for Making Sense, Managing Outcomes, and Meeting Client Demand," ([pdf](#)) we report that addressing these limitations would help advisors to better satisfy their client's growing demand for impact investing.

For one, we should be using the tools and firms the non-profit sector relies on to evaluate their programs and communicate outcomes. Sometimes it's as simple as setting clear, long-term objectives and getting the right information technology to capture certain data.

D.Light, for example, combines sales data, customer feedback, and ongoing field evaluations of its lamps to measure impact on health and productivity. And the Global Reporting Initiative, Impact Reporting and Investment Standards, and Global Impact Investing Rating System are now used by impact investors to measure the non-financial performance of their investments. Bloomberg, Thomson Reuters, and MSCI have also begun to

offer environmental, social, and governance research data to help with investment analysis.

These metrics are good because they move beyond numbers, but they still don't account for context. For example, there's no accounting for the time and place of an investment (say, investing in the energy sector but not education opportunities in Egypt, pre-Arab Spring) or the type and timing of capital deployed (say, mortgage-backed securities in 2007). And they don't look at what else the company might be doing, which could have an equal and opposite impact.

Take Walmart, the largest retailer in the world. It has been installing solar panels on store roofs, generating two times more renewable energy than its closest commercial solar power competitor (Kohl's), and more than that of 35 states and the District of Columbia combined. But even if an investment in Walmart might decrease carbon emissions, it may also create an increase in low-wage jobs, which is a negative impact many investors with social impact preferences would prefer to avoid.

Investors and their advisors need to demand (and help pay for) better data on an investment's holistic impact, and companies need to gather it.

Meanwhile, advisors don't have to wait for more data to change their ways. The new investor is less interested in numbers than in meaning. In other words, advisors should think about why most

potential investors want to invest—what is their ultimate goal? Perhaps they want to save for retirement, or maybe they want to save for a child's college tuition.

Would-be impact investors think about goals on the other side as well: they want to invest in, say, the standard of living for women entrepreneurs in India, or moving more children out of poverty in Washington DC. Perhaps they are interested in a microfinance company. They don't necessarily care how many loans were extended—what they want to know is: did those loans enable families to stay in their homes; did it facilitate better education for their kids; did it change their quality of life?

If financial advisors saw their role as initiating a more meaningful conversation along these lines, they could work backwards to find the impact investments that align with their clients' goals. There are so many ventures doing good in the world, working to address major issues like climate change, rising inequality, and scarcity of resources. We will get more capital to them not only by measuring impact, but by valuing it.

William Burckart is the founder and CEO of Burckart Consulting.

Aunnie Patton

The rapid rise of impact investing

Investing in companies that create social, environmental and economic value is a trend that has been increasing worldwide. This type of triple-bottom-line investing is commonly called impact investing and last year, financial services giant JPMorgan estimated that the market was worth \$60bn worldwide — and growing.

JPMorgan, Monitor Deloitte and the Calvert Foundation predict that the market will increase to between \$400bn and \$1-trillion worldwide in the next five years; and with 22% of global-impact enterprises located in Sub-Saharan Africa, much of the opportunity lies on this continent.

The rise in impact investment is attributed in part to the 2008 financial crisis and the growing awareness that making money for the sake of making money alone is harmful to society and business interests. There has been an increased understanding that some of the most pressing global issues — inequality, climate change and unemployment — pose large financial risks if left unaddressed. This has led to numerous initiatives examining how investing in companies with social and environmental agendas can help uplift and improve living conditions for people, while yielding strong financial results.

The rapid rise of the industry has resulted in a host of new investment products and initiatives, yet there is still a considerable lack of understanding about impact investing, and a lack of substantive information advising investors how to implement an effective impact-investment strategy, most particularly in Africa.

One of the most enduring misconceptions about impact investment has been that it is a trade-off, where financial returns are sacrificed in favour of social return. This is rooted less in fact than in fear. The industry is starting to collect quantitative data providing evidence that a company can be for-profit and for-purpose, without making long-term sacrifices to either goal.

A study conducted by the Global Impact Investing Network and JPMorgan shows that of 143 investors, about 27% said the social impact of their investment had outperformed their expectations. Financially, their impact investments had not beaten their expectations but only 9% were disappointed with the returns. The investors indicated they would invest a further \$12.2bn this year in impact investments, up 16% from last year. As it points out, the real growth rate is probably even faster, considering that as many financial institutions are only now entering the market.

In the US, a small impact investment company, Domini Funds, has been tracking socially responsible companies' performance through its Domini 400 Social Index since 1989 and has convincing evidence to show that these companies have been outperforming the S&P 500 for decades. Since 1990, the social index (MSCI KLD 400) has returned an average annual total return of 10.46% compared with the S&P 500's 9.93%. Another misconception is that impact investment is only for wealthy investors. Even those with very limited funds can make a huge difference, depending on where they put their money.

FOR instance, the Calvert Foundation in the US, a non-profit microfinance fund, has a community investment note that allows people to contribute as little as \$20 to promote social enterprises, conservation, job-creation, affordable housing and other development fields and receive a risk-adjusted return on that investment.

Some of these investments will find their way into African enterprises. Foreign direct investment in Africa has continued to surge in recent years. Last year, foreign direct investment was \$80bn compared with foreign aid of \$55bn. This trend is likely to continue and many foreign investors, foundations and trust managers are keen to tackle the significant challenges Africa faces in terms of poverty, infrastructure development, healthcare, education and transport by making sizeable investments in companies dealing these issues.

This has been coupled with an increase in local investment and experienced investors on the continent. Foreign investors frequently look for partnerships with local companies that have the expertise, the location and the know-how to address these problems. In SA, the obstacles faced by load shedding, for example, have given rise to many businesses offering renewable energy and solar energy solutions. Such organisations are looking for investors to help them launch their business and move their operations to the next level.

Solar energy is becoming a lucrative industry as technology prices have dropped. In Germany and Australia solar energy is cheaper than traditional electricity sources. US company SunEdison has been awarded a contract to build the 86MW Droogfontein plant near Kimberley. Eskom has a 20-year purchase agreement with the project.

In the alternative energy market, measuring the return on investment is becoming relatively straightforward. It is less easy to put a price on investing in human dignity or cognitive development in children, for example. One of the sticking points in the impact investing movement has been how to measure if funds invested in social good are having any measurable impact.

When corporations make decisions on how to allocate capital among business departments, they consult reams of data to understand the returns projected and the impact of that capital invested on the rest of the business. Much of the work in impact investing markets is starting to look at how

money invested in social and environmental good could be allocated in a way that uses data to determine the effectiveness of programmes and institutions. One of the innovative financing mechanisms to emerge from this process are social impact bonds.

Social impact bonds first made headlines in the UK in 2010 after they were pioneered by non-profit organisation Social Finance in a pilot project to reduce recidivism among 3,000 short-term prisoners in Peterborough Prison. Three years later, interim figures from Britain's ministry of justice showed a 6% decrease in recidivism among this group, compared to a 16% national increase for the same period. The world took notice.

The concept is ingeniously simple: social impact bonds don't operate on a debt and repayment system. They are social investment vehicles with outcomes-based contracts between government, private investors and philanthropic organisations.

Investors provide capital to underwrite social projects usually funded by tax money and philanthropists. If a project is successful measured against pre-agreed benchmarks, the investor gets a return on the economic value created for government. If the project doesn't work, investors lose their money.

Impact metrics are built into how the funds are distributed, and the concept took off. By late last year, there were more than 100 social impact bonds in operation or in development. In SA, the Bertha Centre for Social Innovation and Entrepreneurship at the UCT Graduate School of Business is working with National Treasury, the Western Cape government and the City of Cape Town to pioneer SA's first social impact bonds to help develop "outcome-based procurement" options to drive social benefits such as job creation and early childhood development.

SOCIAL impact bonds could play a significant role in addressing the limited understanding of what works and what doesn't in impact investing, driving future funding to the most effective providers. They are a proven social upliftment tool and a solution that works. For investors looking to leave a legacy, it's a win-win situation.

There are many investors looking for investments that can make society better as well as generate financial profits. There are many enterprises that can deliver on these mandates and offer in-

vestors excellent conduits for investments in education, health and community development. The time is ripe for fund managers, asset managers, financial portfolio managers and foundation management to educate themselves about the impact investment market and how they can participate not only in creating wealth for a few, but creating opportunities for millions of Africans as well.

Aunnie Patton is the innovative finance lead at UCT GSB's Bertha Centre for Social Innovation and Entrepreneurship and an Associate Fellow at Saïd Business School, University of Oxford.

Aaron Leopold

Big money for energy in Africa must be spent on small producers

A recent US\$10bn pledge by developed countries to boost renewable-energy expansion in Africa is good news, but the funds must be spent wisely in order to deliver empowerment rather than just power, argues Aaron Leopold, global energy representative at Practical Action, an international development charity.

During the recent climate negotiations in Paris, the EU, Sweden and the G7 nations jointly pledged to raise at least US\$10bn for renewable-energy expansion in Africa over the next five years as part of the Africa Renewable Energy Initiative. This is clearly good news, but it must be spent wisely if it is to fund transformational change.

This sum of money might seem like small change

for Western multinational energy companies that raise billions of euros in profits every year. It might also seem logical that big money should be spent on big infrastructure projects that international power developers and operators are familiar with and are good at.

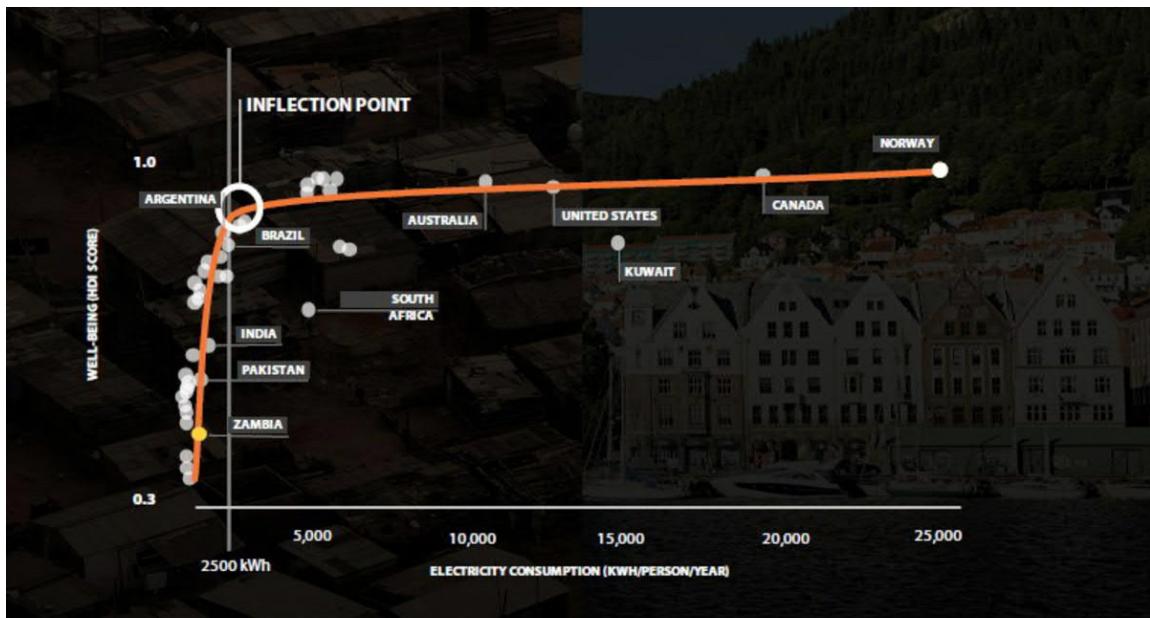
However, the most radical improvements in the Human Development Index (HDI) are seen at energy consumption levels around 10% that of many OECD countries (see chart below). Hence, if the objective of this new US\$10bn is to improve lives, livelihoods and overall well-being, what is needed is investments which support small producers rather than a small number of investments in huge power producers.

Historically, infrastructure projects in Africa have run transmission lines over the heads of,

rather than to, Africa's citizens. On the one hand, it was believed that big industry offered big economic opportunities, but on the other, it was assumed that the overwhelmingly poor population of the continent wouldn't be willing or able to pay for energy anyway. This is why, after 60 years of development assistance, over 600m sub-Saharan Africans still lack access to any kind of modern energy today, and why the International Energy Agency predicts even more may well lack access in the future, as population growth outstrips infrastructure expansion.

However, we are in a period of rapid change and a new breed of entrepreneurs are flipping traditional energy delivery models on their head and showing assumptions about people living in poverty to be completely misguided. Businesses like the Kenyan solar-power company M-Kopa, which sells 15,000 new small solar home systems in Africa per month, provide energy that actually saves their customers money in the long run and improves their lives at the same time by powering lighting, fans, mobile phone charging, entertainment and even refrigeration.

They understand that everyone, no matter how poor, is willing to pay for things that improve their lives. And when you have no electricity at all, it is the first small amount of energy access that makes the most radical improvement in overall quality of life. Astonishingly, governments and large energy producers have failed to grasp this before.



Source: Power for All, The Energy Access Imperative, June 2014

The M-Kopas of the world are also delivering jobs and have the potential to be revolutionary if given the chance. Indeed, the International Renewable Energy Agency (IRENA) estimates that the energy access space can deliver 4m jobs globally by 2030. In another analysis, the UN Environment Programme (UNEP) estimates that over 500,000 jobs can be created by the off-grid lighting industry in West Africa alone. This is significantly more employment than would be possible per megawatt than conventional large-scale fossil fuel-burning power plants could ever offer.

What is encouraging is that donors are slowly getting on board with this reality. Now, rather than offering tediously slow direct incubation support and concessional finance to individual firms, they need to support the construction of an environment where a groundswell of decentralised energy companies can prosper. We need policy and regulatory reform, minimal currency exchange risk, consumer and political awareness, product quality assurance (cheap knock-off products are already seriously affecting trust in this burgeoning market), and import tariff reform. If implemented, we could quickly and meaningfully improve both business and lives across Africa.

Doing this would also encourage skittish private-sector financiers to come out of the shadows and begin talking with these entrepreneurs. The world is awash with cheap credit, but in the energy space at the moment, corporate finance is much more willing to finance bankrupt African utilities than new small and medium-sized energy companies whose products are proving popular.

If spent wisely on learning how to aggregate smaller projects, providing loan guarantees and generally reducing the risk associated with decentralised energy service companies, this new US\$10bn could truly revolutionise energy in Africa by delivering empowerment rather than just power.

Aaron Leopold is Practical Action's global energy representative.

Jacob Winiecki

Financial innovation and solar power: conquering energy poverty

Over one billion people globally live without access to electricity and another billion have unreliable connections. Can more people get electricity with the help of financial innovation? Early evidence suggests yes.

Mobisol and Off-Grid:Electric are two companies working in East Africa to expand energy access in poor communities. They have electrified more than 50,000 off-grid homes in Tanzania over the last two years with their portable solar solutions powered by digital finance, and are on pace to reach more than 200,000 homes by the end of 2015. Upwards of 80% of their customers would remain energy poor if it weren't for such financing innovations powered by mobile money. Since 2014, CGAP has conducted research on three different product types with three leading PAYG energy providers in East Africa: a) Angaza Design's PAYG tech platform enabling short-term payment plans for the cheapest and most portable entry-level solar lights; b) Mobisol's three-year lease-to-own financing for larger solar home systems; and c) Off-Grid:Electric's solar-as-a-service via a ten-year lease. While each product faces unique operational challenges, all three businesses rely on financing to deliver a PAYG solar experience to underserved consumers.

From our work with these companies, we are learning that the widespread availability of small-value payment systems like mobile money – through platforms such as M-PESA, Airtel Money

and TigoPesa – combined with new pay-as-you-go (PAYG) technology can dramatically improve affordability of solar energy products. In fact, our experience shows that even if digital financing mechanisms are not ubiquitous and widespread, their mere availability radically increases overall adoption of solar products and helps businesses extending end-user financing to reduce costs. Moreover, these companies are extending the reach of formal finance by offering people a compelling reason to enter into a financial relationship.

The solar market is ripe for analysis and experimentation because the core technology is relatively stable in terms of cost and reliability, and innovation in financing is driving scaled uptake across multiple markets. In developed markets, innovative solar leasing models have unlocked consumer demand and significant investment in the sector. We're seeing a similar pattern emerging in developing markets, where decentralized solar solutions are proving to be a much more affordable and effective method of providing electricity access to almost one-third of world's population underserved by traditional grids. High quality solar solutions exist, but typically require a significant up-front investment. Until very recently, extending credit to such consumers to purchase a solar solution was simply too expensive given the risk level (and lack of credit history) and high transaction costs (via manual cash collection and management). Dozens of PAYG solar companies are now

able to extend end-user financing to consumers in Africa and Asia who are predominantly rural, underserved by the national electricity grid, and often unserved by formal finance.

Financial innovation is expanding access to electricity in two ways.

1. Financial innovation makes electricity up to 65% more affordable than before.

By dramatically reducing these transaction costs and the risk of cash management fraud, mobile payment options in Kenya and Tanzania allow Angaza, Mobisol, and Off-Grid:Electric to deliver solar energy services to the customer's doorstep at a price that can be significantly more affordable than what that same household or business was spending on kerosene and other alternatives. The average off-grid household in Tanzania spends about \$15 per month on home lighting (two kerosene lamps), mobile phone charging, and disposable batteries for radio and torches. While some solar solutions are available in larger Tanzanian towns, the high upfront cost (\$100+) makes them unaffordable to most of the off-grid market with limited savings and access to finance.

By spreading that investment over three years or more, Mobisol and Off-Grid:Electric are able to deliver modern electricity to highly unbanked Tanzanian consumers at a price point that's less than these existing expenditures. For example, Off-Grid:Electric's entry-level energy-as-a-service offering can provide that same household with electricity via a solar home solution at one quarter of what they were spending on kerosene and other traditional energy sources. Over ten years, the household can save almost \$2,000 in avoided energy expenditures by switching to a PAYG solar system. Mobisol's three-year payment plans for larger solar home solutions also save customers money immediately, but the bigger reason to invest is the long-term savings. After paying off the asset in three years, the product will deliver free energy for at least the next seven years. Angaza's flexible PAYG technology platform enables partner solar product companies and distributors to customize pricing along multiple variables for customer segments to reach a price at or below the price of current energy expenditures. Our research with these companies indicates that reaching an ongoing energy top-up price point – i.e. daily, weekly, monthly incre-

ments – that is lower than previous expenditures is critical to sales uptake and timely repayment.

Mobile payments give off-grid consumers more control over how and when they pay for energy services, introduce a level of transparency unavailable with brick-and-mortar financing – through an instant verification that their solar device was credited for the exact amount sent – and flexible financing that can allow for payments and consumption to better match how and when a household earns money throughout the year.

2. Financial innovations are enabling these providers to reach significantly more customers, faster than ever before.

By packaging the solar asset and financing for end-users at the point of sale, PAYG solar providers are no longer constrained to serving the geographies and customer segments favored by existing financial providers – a major barrier until recently. Mobisol and Off-Grid:Electric can target high-density off-grid areas without a single bank or MFI branch, leveraging technology to deliver a form of end-user finance that's lighter touch, fully digital, and potentially lower risk than existing consumer finance models.

Sales agents for both Mobisol and Off-Grid:Electric use proprietary mobile apps to collect new customer data – such as demographics, photos of the customer and their home, GPS locations of homes and businesses – and either make a credit decision on the spot, or upload the information to headquarters for instant credit assessment and approval. Mobile payments and PAYG tech dramatically reduce the need for in-depth, in-person risk assessment, allowing these companies to approve significantly more customers than a bank or MFI would consider. For example, Off-Grid:Electric's perpetual leasing model allows the company to approve almost any customer who is off-grid, uses a mobile phone, and can pay the upfront connection fee. If any customer goes for more than 30 days without topping up, Off-Grid:Electric can take back the system, refurbish, and redeploy it to a new paying customer in less than seven days. This is perhaps one of the biggest advantages of PAYG solar as a financial product: companies are financing a physical asset that can be remotely switched off, repossessed, and redeployed or re-sold. Mobisol operates with similar attributes and retains

similar advantages, but with longer repayment terms and larger amounts of financing.

This ability to deliver point-of-sale financing, virtually anywhere, is having profound impact on the uptake of solar. In Kenya, research with Angaza Design indicates that short-term payment plans enabled by digital finance can increase uptake of portable solar lights by 2-5 times over baseline sales when the customer is required to pay the full amount in cash up front. Customers who successfully pay off such portable solar lights can leverage this first repayment experience with Angaza's PAYG platform to be automatically qualified for the purchase of higher functioning solar products serviced by the company's same technology platform.

The impact of financing innovation on the solar home system category can be even bigger as the

higher ticket price of such products (\$100+) is unaffordable to a majority of the market on a cash up front basis.

The benefits of PAYG solar are not just limited to conquering the energy poverty trap, however. These solar operators are signing customers up for mobile wallets and giving them an incentive to continue using mobile money. In this way, they are becoming drivers of financial inclusion.

Jacob Winiecki is a consultant for CGAP (Consultative Group to Assist the Poor).

Technology

Aamir Saeed

No phone signal in a disaster? Solar network 'in a box' to the rescue

Pakistani researchers have developed a portable, solar-powered mobile phone network for use in disasters like floods and earthquakes when regular communications are often disrupted. Researchers at the Information Technology University (ITU) in Lahore, together with a team from the University of California, have developed a prototype "Rescue Base Station" (RBS) for Pakistan - the country's first emergency telecoms system that would work on normal cell phones.

"When the RBS is installed in a disaster-struck area, people automatically start receiving its signals on their mobile phones. They can manually choose it and then call, send messages and even browse (internet) data free of charge," said Umar Saif, ITU vice chancellor and an adviser to the project.

The RBS is a lightweight, compact rectangular box fitted with an antenna, a signal amplifier and a battery, which can be carried easily and even dropped by helicopter in hard-to-reach disaster zones. It has a solar panel to charge the battery, to keep it working in places without electric power.

An alternative communications system like this could help save lives when disasters strike by connecting survivors with rescue workers and government officials. The RBS has yet to be deployed on the ground, but the ITU expects it to be used in the next six to eight months in partnership with the National Disaster Management Authority and a local telecoms company.

Saif said the RBS signal can be received within a 3 km radius, and people in the area can easily register by sending their name, occupation, age and blood group to a special number. "This helps generate an automatic database of people in distress, and eventually helps both the rescue and relief teams and the victims," he said.

Pakistan has 116 million active cellular subscribers out of a total population of 185 million, according to official data.

Information on demand

Potential users of the RBS system can get the information they need in just a few seconds by sending a text message to specific numbers appearing on their mobile phone.

For example, if a person needs to contact a fire brigade, they text the words "occupation: firefighters" to the relevant number. They will then receive names and contact details for local firefighters in just a few seconds and can call for help, Saif said. Or if someone needs access to blood supplies, they send a message saying "blood group, B positive", for instance, and receive contact information for people nearby with that blood group, so they can ask for a donation.

Saif said RBS teams on the ground plan to collect information about disaster-affected people in a database, and pass this on to rescue teams, doctors and government departments that can provide assistance. "(They) can also send weather forecasts and disaster alerts to subscribers, and

help them evacuate troubled areas," said Ibrahim Ghaznavi, an ITU researcher and one of the RBS developers.

The RBS, which operates using open source software, offers all the features provided by regular cellphone companies, he added. Ghaznavi said it costs around \$6,000 to develop an RBS, and the Pakistan prototype has been funded by a Google Faculty Research Award.

Tech Innovation

The RBS team is now working with Endaga, a U.S.-based company that connects rural communities through small-scale independent cellular networks, and a local telecoms firm to commercialise the project, he added.

The aim of the collaboration is to help phone companies keep their communications systems functioning in a disaster until their regular networks are restored.

Pakistan is a disaster-prone country, which needs \$6 billion to \$14 billion to help it adapt to climate change impacts, such as unusually heavy rains, droughts and melting glaciers, through to 2050, according to a 2011 study funded by the U.N. climate secretariat.

The International Federation of Red Cross and Red Crescent Societies developed a customised

communications system called the Trilogy Emergency Response Application (TERA) in Haiti when it was struck by a massive earthquake in 2010.

But that system could only send text messages to its subscribers on their mobile phones, unlike the RBS which allows users to call, send texts and even browse the web for free.

Cutting-edge technologies like the RBS could help save more lives by delivering timely advice to disaster-hit people, said Pervaiz Amir, country director for the Pakistan Water Partnership. "Local researchers should be encouraged to develop innovative solutions to help people in distress," he said. But the RBS needs to be tested in the field under different conditions before being deployed on a wider scale in actual disaster zones, he added.

Amir said the RBS could be useful for rescue and aid activities, especially in remote rural areas of Pakistan where natural disasters regularly disrupt poor communications systems.

Aamir Saeed is an Islamabad-based freelance writer for the Thomson Reuters Foundation.

Sally Murray

Focus on poverty: Why the grid isn't always the answer

The World Bank recently announced that between May 2014 and May 2015, Kenya's national energy utility formally connected 150,000 households in urban slums to the electricity grid, up from just 5,000 previously. This massive jump was largely achieved by subsidising families' grid connections (connection fees alone are US\$400), an approach the NGO Innovations for Poverty Action is now trialling in rural parts of western Kenya.

The electrification of poor settlements clearly improves everyday life for poor families. [1] Safer, cheaper lighting and improved communications through mobile phone charging, radios and TV bring obvious benefits. When it comes to health services, energy can be a lifeline, enabling cold chain storage for vaccines and encouraging health workers to stay long term in electrified villages.

But in most cases the electrification of poor rural settlements has yet to spur the transformational economic growth — in productivity, manufacturing and off-farm employment — that many had hoped for. Evidence suggests that, when it comes to turning around rural livelihoods, targeted government support for off-grid energy often holds greater promise, with farmers reaping the most benefits.

There are several reasons why improved energy access has failed to transform rural economies. Poor entrepreneurs tend to use electricity to operate small, consumption-focused businesses — for example, charging phones, refrigerating drinks, running small cinemas — or to keep small stores

open after dark. These service-sector enterprises don't become much more efficient as they grow, and hence tend to stay small, limiting their potential to create jobs or spark virtuous spirals of productivity growth. Even among firms with more potential to grow, energy is not usually their main barrier — a survey of small enterprises in six developing countries found it represented no more than four per cent of firms' total costs. [2]

But 70 per cent of the world's poor depend on a livelihood that is transformed by electrification: farming. An electric irrigation pump can quadruple a farmer's yields and dramatically improve how stable a crop's yield is over time. Yet almost all farmers in Sub-Saharan Africa rely almost exclusively on rain-fed agriculture, while many farmers in South Asia depend on canal and flooding methods which are rain-dependent and thus unreliable; just 35 per cent of agricultural land in India is reliably irrigated.

The grid isn't the solution here, due to frequent and sustained power outages in many countries. For reliable irrigation, many farmers must therefore invest in off-grid pumps, powered by solar energy or diesel/butane. Of the two, the upfront costs are higher for solar, at US\$3,000-\$7,000 per pump before subsidy versus US\$500 for diesel pumps. But solar has the greatest transformative potential: compared to diesel, it saves farmers money in the long run, it saves hundreds of thousands of tonnes of carbon dioxide and it can reduce huge government expenditure on subsidies for imported diesel.

Uptake of solar pumps has been low, however. A lack of information and finance seem to be the main barriers: almost all solar pumps installed in developing countries were promoted heavily, and sold at a highly subsidised price. In Punjab in India, for instance, solar pump purchases dropped from 460 a year in 2000-04 to zero in 2005-13 when the government subsidy was reduced from 90 to 30 per cent. Punjab's solar pump penetration is low, but still almost the highest in India, with no other state offering such generous subsidies.

The case of agriculture, then, highlights the potential gains from better targeting of energy investments. Currently investments in household electrification and grid roll-outs dwarf investments in off-grid irrigation. Governments and donors who are serious about ending poverty and dramatically improving rural lives should make off-grid irrigation support for farmers a far bigger part of their energy portfolios.

References

- (1) The welfare impact of rural electrification: A reassessment of the costs and benefits — An IEG impact evaluation (The World Bank, 2008)
 - (2) Andrew Scott and others: How does electricity insecurity affect businesses in low and middle income countries? (Overseas Development Institute, July 2014)
-

Sally Murray is a country economist at the International Growth Centre (IGC). She works in Rwanda, overseeing the IGC Rwanda's research on urbanisation, energy, public sector performance and tax.

Ed Rodriguez

Is solar-powered LED lighting finally getting a chance to shine?

For a good many years, there have been periodic articles about "solar powered lighting," a supposed creative way to bring lighting to where connection to the grid is next to impossible. But a little cost/benefit analysis has always seemed to put a damper on things. Although there are now dozens of firms in the US which offer such products made in the US or China, there has so far been little traction.

So, what's the problem here? In a basic system, a solar panel charges a battery during the day and the battery then powers an LED light fixture at night. Sounds simple enough, right? The fact that an LED requires so much less electricity than an incandescent lamp makes the idea worthy of discussion. Furthermore, the inherent directivity of LED emitters makes them much better than any HID lamp in actually delivering lumens to a desired surface, no matter what the specs seem to say for any HID luminaire.

But the devil's in the details. First of all, a solar panel rated at X watts only delivers those watts at noon in a cloudless sky. In reality, if you do a little 5-minute test yourself with a simple ammeter connected right across any solar panel output to measure the short circuit current (yep, that's what you do to measure the panel's efficiency in changing light levels), you will find that any solar panel (they're all "fundamentally" the same no matter what you've been told) with an overcast sky will only deliver 20-30% of its rating, and only 50-

70% in a cloudless sky in the morning or late afternoon.

This really means that unless you are located in Phoenix or the Sahara, you need a solar panel 2-3 times what you might think to be sure a battery bank will always be adequately charged. The good news, however, is that solar panel pricing, like LEDs, has dropped like a rock in the last 3-4 years. Panels are now readily purchasable for a dollar a watt.

Now that we know the solar panels need not be a major cost issue, we need some healthy batteries. While you might see some systems using lithium or gel cell batteries, the best bang for the buck (cost, performance, and compatibility with simple charging techniques) for higher power is likely the popular Absorbent Glass Mat (AGM) sealed lead acid types, which have a lot of capacity and are probably less than \$2 per AH. But you don't want to let the battery discharge down to less than 30-40%—meaning you really want to use twice as much battery. Still not a big deal on cost, but the size has historically started to get onerous if we wanted a parking lot luminaire of more than 100W to be on all night long.

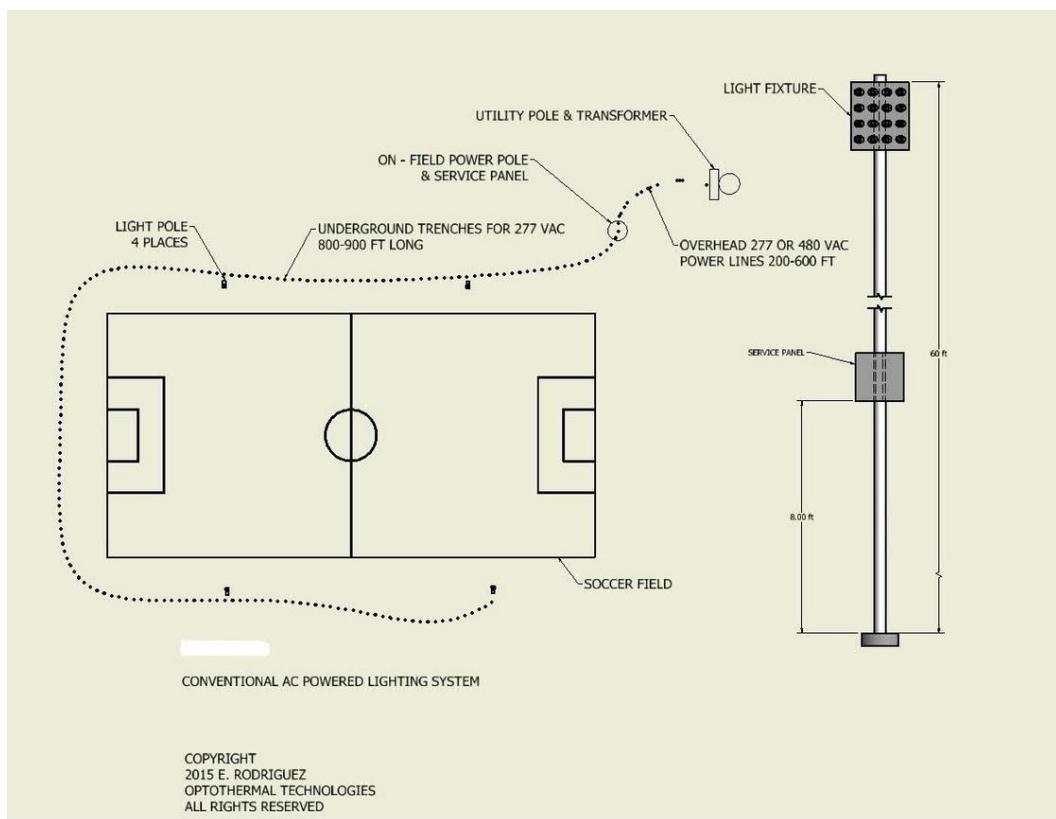
However, things are changing. LEDs at 5000K have gone from 50 LPW (lumens per watt) in 2006 to more than 150 LPW in 2015. And not just in some company's R&D lab, but actually for sale off the shelf from Nichia, Cree, Lumileds, and others. This means reduced size and cost for batteries and

solar panels, making that tiny niche market a little larger.

The killer in all this is when we need those lights on all night at full brightness. Yes, many firms say you can greatly reduce battery demand by dimming for most of the night or using motion-detection to keep the luminaire at greatly reduced power most of the time. However, that sales pitch has generally been a non starter in mainstream applications. If somebody wants a parking lot light on for security purposes, they want it on at full brightness all night.

Let us jump to an area where solar powered

lighting in fact offers surprising benefits. There are now more than 25,000 non-stadium-type youth athletic fields in the US which have no lighting at all. Many of these are also used for youth lacrosse and football practice. If you want to bring lighting to such a field, where no AC mains power has previously been present, it will cost you (the community) between \$150K-200K—best case—to dig long trenches, bury high voltage cables per code, bring in overhead power from a distant utility pole transformer, install various service panels per code, and undergo perhaps a 12 month aggravating process with a utility company.



The traditional \$150K-\$200K process to bring in AC mains power for youth sports field lighting can be reduced to less than \$50K if solar power is used.

The major cost is not in the LED luminaires and poles but in bringing in that AC power—an eye-opening challenge. The massive task of doing all that trenching, HV-cable laying, and utility connection is totally eliminated with solar. A small field

can be lighted in a week via solar powered LED lighting for a fraction of the cost and time. This is made uniquely possible by the fact that youth athletic fields need only be fully lighted for no more than 2 hours a night. The batteries can be

charged “poorly” for 10 hours, even on a cloudy day, but still generate enough charge for the limited time needed for a game or practice several times a week. Philips has already installed some systems like this in Africa and several have now been put in place in the US by other companies, including activity in San Marcos, Texas.

The bottom line is the sharp increase in LED efficacy and drop in LED prices, coupled with drops in solar panel pricing, are making it possible to use LED lighting for surprising new applications,

matched to need and driven by economics—just when we thought there was not much new going on in LED lighting!

Ed Rodriguez is a veteran of the power semiconductor, power supply and LED lighting technology industries.

Tosh Szatow

Three common mistakes when assessing going off grid (solar and storage)

Every consultant and commentator now has a view on solar and storage. The ATA solar and storage will be economic by 2020, Tristian Edis is downplaying going off grid, and you get the feeling Giles Parkinson sees market disruption imminent (we tend to be in the same camp as Giles). Here are the three common mistakes we see when assessing the potential of solar and storage. Read them, critique them, but please, don't make them.

Mistake 1 - the grid is efficient, cheap, back up power supply, and so we shouldn't go off grid. Often, it is argued the grid is efficient and useful, simply because it already exists.

One way to dispel this argument is to ask: "do you use fixed line telephony, in the digital age?" Personally, I don't have a landline. I'm 100% mobile and most people I know are the same. Why use infrastructure, simply because it exists?

The evidence behind this argument typically goes that even if getting to 90% self sufficiency using solar and storage is cost-effective, the last 10% required to leave the grid altogether will really cost you (that much may be true). Therefore, it is best just to stay grid connected.

However, this analysis assumes the grid will cost the same, whether it is used by customers for 10% of the time, or 90% of the time. If network operators and retailers aren't prepared to massively cut their revenue or profit per customer, this

assumption will hold true. In the real world where energy companies care about how much money they make, it will become expensive for you to use the grid for backup 10% of the time.

The result? The grid is unlikely to end up being cheap back up after all. Time will tell, but it is a brave punter to suggest the grid will be cheap back up, when we only use it 10% of the time.

Mistake 2 - economic rationalism - why would people install solar and storage, or leave the grid, if it doesn't make economic sense?

This analysis is always done around an average household, that uses an average amount of power, at an average market price. Like the ATA analysis on solar and storage.

However when it comes to real customers and real projects, assessing an average household becomes problematic. For the energy conscious family that doesn't need heating in winter, the economics of solar and storage, or going off grid, is going to be vastly different to the professional couple that want to charge their EV at home, and live overseas three months of the year.

Stating the obvious, on either side of an average, solar and storage will make sense for some, but not for others. Today, in many market niche's, solar and storage makes sense. This will allow the market for solar and storage to establish a foothold, come down the cost curve, and eventually penetrate the mass market.

How soon? Hard to say, but solar costs in Australia dropped about 70% in 6 months once the global supply chain kicked into gear. Don't expect a gradual, steady decline in battery storage costs. The change will be quick and dramatic, and almost certainly in the next three years.

Mistake 3 - going off grid results in all this wasted solar energy in summer, surely I should sell this to my neighbour?

There are two errors here.

The first mistake is subtle. The argument implies the current energy market is efficient. That is, it implies we shouldn't waste our solar assets, because surely that's not what happens when designing energy infrastructure?!

In fact, that is exactly what happens when designing energy infrastructure - it is designed and built to manage a worst case scenario, and 98% of the year, energy infrastructure is under utilized, or "wasted". Roads, rail, and other infrastructure assets all suffer this conundrum to varying degrees.

Of course, two wrongs don't make a right. We don't advocate replacing inefficient infrastructure with inefficient infrastructure, just for the sake of it. But inefficiency isn't the bogey it's made out to be.

More importantly, the second error is to assume the value of selling excess to your neighbours will be higher than the cost of doing so. At current feed in tariffs, you would need the cost of production to be lower than 6c/kWh for exporting energy to your neighbours to make sense (that is unlikely). Combined with unavoidable charges for being connected to the grid, that are often higher than \$400 a year for households, selling your excess might be more expensive than it is worth.

You might be better off running the air conditioning for kicks in summer, or charging your neighbours electric vehicle for free in summer for karma credits, than selling your excess to neighbours. Sad, but true.

So there you have it. Does solar and storage stack up? It depends, and it depends largely on how network companies price their services.

Tosh Szatow is director of Energy for the People.

Jonathan Gifford

Solar plus storage becoming "new normal" in rural and remote Australia

PV arrays coupled with battery storage systems are becoming the "new normal" in Australia's wide-open spaces. The number of installations continue to increase as governments and businesses begin to realize the new reality of off or edge-of-grid solar+storage affordability.

Rapidly falling costs in solar and battery storage technology, coupled with an increasing familiarity with the technology is driving these solutions into the mainstream in remote areas of Australia. In Western Australia a growing number of innovative solutions are providing proof of the technological solution and its economic advantages.

In a demonstration of the shift in thinking that is taking place, the state's Minister of Energy Mike Nahan has acknowledged the strong economic case for solar+storage and has called for the state's rural and remote utility to accelerate its uptake. Nahan has previously expressed doubts about renewable energy and, as a strong advocate of free-market principals, is not a supporter of subsidies for renewable deployment.

In response to questions raised in the WA parliament last week about the poor level electricity supply to the remote mining town of Ravensthorpe, Nahan said that the local utility Horizon is investigating a number of solutions including a micro-grid with decentralized solar component.

"I am not a technologist," Nahan initially cautioned. "[However] we could tell everybody in

Ravensthorpe to put in solar and have a wind-diesel-solar combination. They already have a micro-grid. These are the things that Horizon is supposed to look at, and we will go down and discuss it."

Nahan continued that he had "entrusted" the utility to come up with alternative electricity solutions for supplies to remote towns such as Ravensthorpe. He has also appointed a renewable energy expert, Ray Wills, to the board of the utility. Wills is the former head of the now-defunct Sustainable Energy Association.

This shift in thinking comes after a UBS report last month that solar+storage is already economic in some parts of Australia.

Real-world applications

While the apparent about-face of the WA Energy Minister is impressive, solar+storage arrays are going into remote Australian communities on an increasingly regular basis.

In the mid-west region of Western Australia, the Meta Maya Regional Aboriginal Corporation has announced that it will install a 100 kW solar+storage system at its headquarters in Wedgefield, Port Hedland. The array will be coupled with a 76 kWh lithium ion battery bank and backed up by a 40 kW diesel generator.

Due to technical constraints put on solar arrays by the utility Horizon Power, it made financial sense for the Meta Maya Corporation to go off the

grid. EMC Solar Construction will supply and install the system.

"EMC had been engaged to install a grid connect solar array at our new office and depot in Port Hedland, but due to constraints required by Horizon Power, the system was not financially viable," said Luke van Zeller, Meta Maya's GM. "EMC was able to engineer and demonstrate that we would be better off installing a larger solar array connected to a large battery that would produce and store all of the energy we would need, and at a lower cost than our current Horizon tariff."

Meta Meyer, which provides a range of services across the remote Pilbara region of Western Australia, hopes to begin developing similar off grid solutions for industries in communities in the area. These include remote Aboriginal communities, mining companies and agricultural operations – all of which can be literally thousands of kilometers from major electricity grids.

"We are seeing an increase in the number of energy consumers who are willing to take courageous efforts to side-step the constraints that are being imposed on them by the electricity suppliers," said EMC's John Davidson. "Meta Maya is one of those companies that has a vested interest in finding better ways to provide power and water services to the remote communities of Western Australia."

Mary's Farm Cottages 40 kW system

In the south of the vast state, solar+storage arrays are also proving economic. In the grain-growing region inland and south of the state capital of Perth, a 40 kW solar+storage system has been installed to supply holiday accommodation on local rural property.

Local off grid specialists Solarmatrix designed the system, carried out the assembly at its headquarters in Perth. A 188 kWh Sonnenschein battery system has been coupled with 6 SMA Sunny Island 3-phase battery inverters to store the solar electricity. A 50 kWA diesel generator provides backup power, however Solarmatrix notes that it hasn't been used even once since the solar+storage system was commissioned on October 27.

Solarmatrix notes that solar+batteries provides not only cheaper electricity in these remote off grid applications but also provides far more reliable power, as most diesel generators aren't designed for 24/7 use.

The system was partly funded by a regional tourism grant. Solarmatrix has previously installed a number of off grid solar arrays with battery systems in remote communities.

Jonathan Gifford is Editor in Chief at pvmagazine.

Aamir Saeed

Solar-powered ATMs to deliver clean drinking water in Pakistan

Punjab province is set to launch an innovation for water-short Pakistan: Solar-powered ATMs that dispense clean water when a smart card is scanned.

The two-foot-square prototype machine looks and functions like an ATM, but dispenses water instead of cash. Users are issued a card they can use to claim a daily share of water.

The project, a collaboration between the Punjab Saaf Pani (Clean Water) Company and the Innovations for Poverty Alleviation Lab (IPAL), a research centre in Lahore, aims to install a water ATM on each of a series of water filtration plants being established in rural and urban fringe areas of Punjab province.

The machine is designed to help the government cut water waste and ensure people have access to clean water, said Jawad Abbasi, a programme manager at IPAL.

"The innovative machines will help the government maintain a record of the exact quantity of clean drinking water being dispensed in a day in a specific locality, besides ensuring its quality," he said. The quality and quantity of water being dispensed will be tracked in real time online, through a central server, he said.

How it works

The devices play an audio message upon authentication of a scanned card, after which they dispense water for the user. Green and red buttons

enable the user to start and stop the flow of water. A flow control meter manages how much water is dispensed, and sensors measure the amount of water still available.

In its first phase, the project will cover three districts of Punjab including Bahawalpur, Rajanpur and Faisalabad, all areas with particularly serious water contamination issues, experts said.

Each beneficiary family will be entitled to collect a maximum of 30 liters of clean drinking water daily from the filtration plants with their unique identity card, Abbasi said. "We are planning to install the machines at 20 filtration plants in the first phase that will benefit some 17,500 families," he said.

He said that his organisation was seeking \$23,500 in aid from the UK Department of International Development to put the prototype into production and install more of the dispensing machines at existing water filtration plants in Punjab.

Similar card-based water dispensing systems are already in use in neighbouring India.

Push to improve water access

According to Punjab Saaf Pani Company, only 13 percent people in rural areas have access to tap water, compared to 43 percent of people in urban areas of Punjab. The province, with 98 million people, is the country's most populous.

The government of Punjab aims to provide clean drinking water to over 35 million people by

the middle of 2017 and some 20 billion rupees (almost \$200 million) is being allocated for the effort in the upcoming budget, said Muhammad Farasat Iqbal, chief executive officer of Punjab Saaf Pani Company.

"It's one of the top priorities of the provincial government, to ensure provision of clean drinking water in each locality, as access to clean water is a fundamental human right," he said.

Iqbal said the clean water would be provided free of cost but beneficiary communities would pool money each month to pay for maintenance of the ATMs and filtration plants.

According to Pakistan's national drinking water policy, 35 percent of Pakistan's population doesn't have access to safe drinking water. The policy estimates that diseases related to water, sanitation and hygiene issues cost Pakistan's economy about 112 billion rupees (\$1.1 billion) each year in health costs and lost earnings.

Nazir Ahmed Wattoo, an environmental expert

with the Punjab Anjuman Samaji Behbood (Organisation for Social Welfare) said few water conservation systems are in place in Pakistan, resulting in waste both in daily use and in agriculture.

By regulating and measuring the water used daily in a specific area, he said, the government can better manage the scarce resource. The real test, he said, will be whether the water dispensing centres are maintained and effectively monitored.

He said the centres also need to be supported by a concerted national effort to build new water reservoirs. Pakistan's water storage capacity is currently just 30 days, a quarter of what neighbouring India says is needed.

Aamir Saeed is an Islamabad-based freelance writer for the Thomson Reuters Foundation.

SciDev.Net

Egyptian method filters seawater in minutes

Researchers at Alexandria University in Egypt have unveiled a cost-effective desalination technology which can filter highly salty water in minutes.

The technology is based on membranes containing cellulose acetate powder, produced in Egypt. The powder, in combination with other components, binds the salt particles as they pass through, making the technique useful for desalinating seawater. "The membrane we fabricated can easily be made in any laboratory using cheap ingredients, which makes it an excellent option for developing countries," says Ahmed El-Shafei, an associate professor of agricultural and biosystems engineering in Alexandria University, and an author of the study.

The technology uses pervaporation, a technique by which the water is first filtered through the membrane to remove larger particles and then heated until it vaporises. The vapour is then condensed to get rid of small impurities, and clean water is collected.

According to the research paper, published in Water Science and Technology last month, this method can be used to desalinate water which contains different types of contamination, such as salt, sewage and dirt. This kind of water is difficult to clean quickly using existing procedures.

The membrane technology in combination with vaporisation can be applied in remote settings, as it requires only the membranes for the filtering process, and fire to vaporise the filtered water, the researchers say. "Using pervaporation eliminates

the need for electricity that is used in classic desalination processes, thus cutting costs significantly," says El-Shafei. Pervaporation is used to separate organic liquids, like alcohols, and is one of the more common systems used in sewage treatment to separate water from organic solvents. The technology has been around since the mid-90s, Helmy El-Zanfaly, a professor of water contamination at Egypt's National Research Center.

But, he says, "What is new is making the membrane locally, using materials abundant in Egypt and developing countries." El-Zanfaly adds that existing pervaporation membranes are fabricated using complicated procedures, making them unsuitable for cheap production.

"The technology implemented in the study is much better than reverse osmosis, the technology currently used in Egypt and most of the countries in the Middle East and North Africa," El-Zanfaly says. "It can effectively desalinate water with high concentration of salt like that of the Red Sea, where desalination costs more and yields less."

The technology can be adapted for commercial use by fabricating larger sheets of the membrane and cutting these into suitable swathes, according to El-Shafei. The next step for the team is to establish a small desalination unit as a pilot project for the technology.

SciDev.Net is a source of news about science and technology for global development.

Taha Selim Ustun

How Rwanda's clinics have gone off-grid and onto renewable energy

Rwanda is located in the poorest region in the world, sub-Saharan Africa. Despite this, it is making advances with off-grid renewable energy solutions for rural areas that could be a model for similar economies.

Rwanda has harnessed its endowment with enormous, untapped renewable energy generation potential to address the problem of how to get energy into remote parts of the country.

The approach being taken accepts that extending the electricity grid to remote areas is fraught with problems. It is expensive, transport costs are high, and accessibility is difficult. In sub-Saharan Africa, grid-extension costs \$23,000 per kilometre.

A project to get clinics in remote areas of Rwanda onto reliable sources of renewable energy has recently been stepped up a notch with the introduction of technology that smooths distribution.

Small-scale generation for remote areas

Off-grid electrical systems, where power is derived from renewable energy, have the potential in Rwanda for taking advantage of several types of small-scale generation. This has become more feasible with the development of new technologies that have revolutionised the possibilities for making these systems highly resilient and economically sustainable. Examples include smart meters with wireless communication and sophisticated technology for fine-grained monitoring and control.

Rwanda is taking advantage of developments such as this to crack the problem of getting electricity to remote clinics.

Uninterrupted access to electricity is a key requirement for improving care in health facilities. But access to either grid or off-grid electricity is still one of the grand challenges for rural health centres in the region. One-quarter of health facilities are not connected to any source of electricity. On average, three-quarters of facilities have no reliable source of electricity. This leads to a poor health care service delivery.

83% of Rwanda's population live in rural areas. This makes healthcare in these areas all the more important. And ensuring that healthcare centres have power is vital.

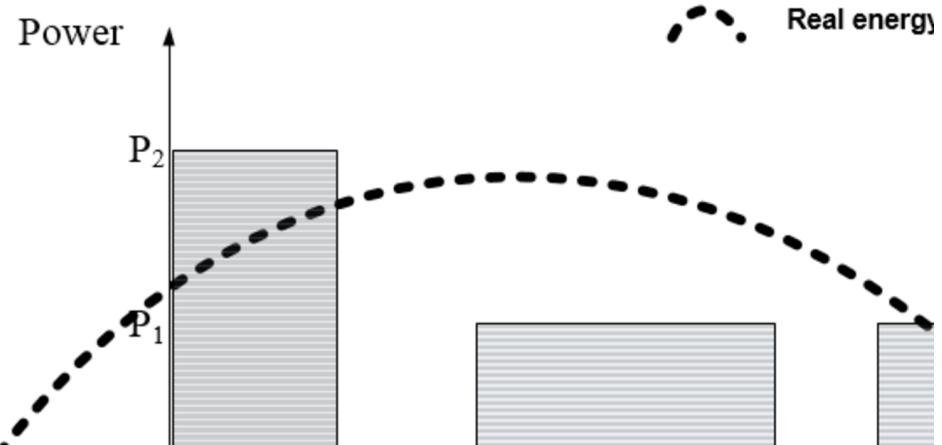
To overcome this obstacle decentralised power sources such as PV systems are becoming popular in rural areas because of their cost effectiveness compared to grid extensions. PV systems basically convert solar energy to direct current electricity using semi-conducting materials. But these have not proved adequate in matching supply with demand because:

- Health centres operate on a first-come first-serve basis. If health centres continue to use connected electronic devices without proper management, the chances of blackouts will increase and patients will suffer.
- Unused energy from fewer patients than expected also presents a problem as energy is

wasted. Making batteries available to store energy can be a way to ensure less is wasted, help avoid shortages and manage excess demands. But this option is expensive.

The graph below shows the ad-hoc scheduling of energy services in PV-power health clinics.

Between t0-t1, the power demand exceeds available solar power. The t1-t2 window sees no load. This results in some services not being delivered, unnecessary use of batteries, and hence a shorter life-time, and less orderly operation.



Existing ways scheduling show overutilisation and underutilisation of the energy generated by solar systems.

Smart scheduling has done the trick

Smart scheduling is used to match consumption of active services with the available solar power. This results in minimum use of batteries or other energy sources.

The idea lying behind is as follows: the central controller estimates daily solar profile of the PV panels by pulling solar radiation information from online servers. Then when a physician wants to undertake an operation that requires electricity he sends a request to the central controller. This request includes power consumption and the duration of the operation.

In our prototype, the final decision lies with the system. Different services have different priorities. So, a surgery room may be given the highest priority during system planning. If an emergency occurs and a surgery room is fed into the system, it will be given the highest priority.

But human intervention is possible. The central controller is a photo voltaic (PV) inside the clinic. This means that a clinic administrator or the high-

est ranking physician can tap into the system, remove some services from the list and add some others.

The central controller checks the available solar power and the loads that are already being served. If there is sufficient excess energy, the request is confirmed and the energy is delivered. If there is not sufficient energy the controller schedules the request to when there will be enough energy. This may happen due to solar radiation, hence the generation, increasing or a service that was already receiving energy load being terminated.

In this way, facilities are used in a smart way and solar generation is used as it is generated.

Taha Selim Ustun is Assistant Professor of Electrical and Computer Engineering at Carnegie Mellon University.

Dana Dovey

Water shortage problem solved with solar power? MIT makes salt water drinkable

Water is necessary for all forms of life, but although 71 percent of the Earth is covered by water, the majority of it is salty and incomsumable. A team of MIT engineers believe they may have found the answer to the world's water crisis with a design they claim can harness the power of the sun to make salt water drinkable.

Desalination, or removing salt from water, is already a popular practice in areas prone to droughts. Unfortunately, the process is expensive and wasteful — two components that make it ineffective for third world countries, Popular Science reported.

In order to help address the problem, USAID, the U.S. Agency for International Development, set up a competition to find the most cost-effective and environmental desalination process for developing countries. Amos Winter, an assistant professor of mechanical engineering at MIT, and Natasha Wright, a doctoral student, emerged as the winners with their solar-run electrodialysis method.

In the technique, dissolved salt, which naturally has a slight electric charge, is drawn out of the water with an electrical current. The technique also disinfects the water by shining it with a UV light, PopSci reported. "It works kind of like an electric circuit," Wright explained to The Boston Globe. "The ions get pulled out of the water toward the electrodes."

While electrodialysis is a well understood prac-

tice, what makes the design significant is its use of solar power. The entire machine is run by solar-charged battery panels. Most desalination techniques run on fossil-fuel, which makes them both expensive to run and detrimental for the environment. Using solar panels eliminates both of these negative attributes.

The MIT design is also far less wasteful than typical desalination processes. Reverse osmosis is the most common way to draw salt out of water, but according to Wright, this technique can waste around 40 percent of the water used. The solar-run electrodialysis discards only about five percent of the water used, The Globe reported.

The team won the first prize of \$140,000 to test their method. The technique has so far been tested for its durability, an important factor for its use in poor rural areas. A machine which requires constant expensive upkeep would be out of the budget for many communities. The technique proved successful after being run for 24 hours straight at the Brackish Groundwater National Desalination Research Facility in New Mexico. As reported by PopSci, the next step is to see how the method performs in harsh environments and after constant use.

Although the technique is not yet available for practical use, if it proves effective it could be a major stepping stone in the effort to provide the world with usable water. In areas like India the population vastly supersedes the amount of safe,

drinkable water. But the current drought in California has brought the problem of water shortages closer to home for some.

According to Glenn Vicevic, a product manager at General Electric's Co.'s power and water business unit in Oakville, Canada, there's no reason for the design to not work correctly.

"Electrodialysis technology is well understood," Vicevic told The Globe. "If you combine that with

properly sized solar cells and you have properly sized batteries, there's no reason you couldn't achieve it."

Dana Dovey has an MA in Journalism and Media Communications and is writing for Medical Daily.

Varun Mehra

Solar pumps: India's potential to link electricity access and irrigation needs?

Currently, over 300 million people in India lack access to electricity — almost the size of the entire population of the United States. Increasing energy access has become an economic opportunity, with companies providing off-grid (i.e., solar lanterns or solar home systems) or microgrid solutions (localized, small-scale generation typically serving residential loads). These options help rural customers move away from burning relatively expensive fuels such as kerosene and can provide basic energy services such as lighting and cell-phone charging, but they do not always provide enough electricity to meet economically productive needs. In India, over 50% of the workforce is employed in the agricultural sector so there is an enormous opportunity to link residential electricity needs with agricultural electricity needs, like the electricity needed to power irrigation pumps, and provide a more comprehensive electrification solution.

Today, most Indian farmers typically rely on the monsoon for watering crops, however, irrigation can increase crop yields up to four times. But irrigation requires energy. Currently, it is estimated that 26 million diesel and electric pumps run on Indian farms, making them the dominant technology offerings today. However, grid-connected pumps that rely on electricity face the same challenge that any other load connected to India's central grid faces: frequent outages. Having electricity flow through wires in the middle of the night

isn't helpful for farmers or laborers who need to pump water during the day. In addition, diesel-based pumps burden farmers with high recurring fuel expenditures, which can be as much as \$250/year — eating away at what could otherwise be disposable income.

The lack of access to dependable pumping solutions hampers livelihood improvements throughout rural India, but solar water pumps are emerging as both a reliable and clean energy solution. If solar pumps can be treated as anchor loads — loads that have consistent electricity needs — they can be integrated into solar-powered microgrid systems, opening new opportunities to link electricity access solutions with the other needs of rural Indian communities.

From a policy perspective, solar pumps have been gaining a lot of attention in India for good reason. Electric irrigation pumps currently account for over 20% of the load on the grid. Through over-subsidized electricity prices and fuel subsidies, the combination of electric and diesel pumps costs the government roughly \$6 billion each year. Thus, it's no surprise that Mr. Tarun Kapoor, the Joint Secretary of India's Ministry of New and Renewable Energy in India, has said that, "Irrigation pumps may be the single largest application for solar in the country."

Given the potential economic opportunity, there has been an influx of private players offering solar pumping alternatives, from large companies

such as Jain Irrigation, Tata Power Solar, and SunEdison, to smaller companies such as Claro and Atom Solar. That doesn't mean solar pumps come cheap. A one horsepower solar pump can cost around \$3,000 — an upfront cost typically unbearable for most small, marginal rural farmers with a couple hectares of land or less. And despite the number of subsidies enacted at the state and federal level in India, only about 12,000 solar pumps have been installed nationwide.

Roughly in parallel, microgrids have been looked to as an electrification solution that can provide clean, reliable electricity to off-grid communities in India. When it comes to microgrids, one of the biggest challenges is determining how to size the system (i.e., how many solar panels, size of battery, etc.). Usually, the size is based on a standardized amount of energy provided to each consumer (i.e., daily allotments of lighting/cell phone charging). Some microgrid developers look to anchor loads as a source of consistent demand (and revenue) that can allow them to build a larger system that can accommodate the unpredictability of residential electricity demand. The prime example is providing backup power for telecommunications companies to ensure continual operation of cell phone towers; companies such as OMC Power specialize in this area. Similarly, the combination of challenges that face those seeking to deploy solar pumps and electricity access solutions actually creates a unique technical and economic opportunity.

Here's how this solution could work. Starting with the pump, the amount of solar power needed depends on the specific water table depth of a farm; the further the water is from the ground, the more power would be needed to pump that water up for irrigation. This in turn depends on the geography of a particular region; taking the Indian state of Bihar as an example, water level depths vary between 2-5 meters below ground level, so for one hectare of land, an estimated 600 watts of solar would be required for pumping water.

However, since water for irrigation is only needed during certain hours of the day, using the solar pump as an anchor load in a microgrid could be a way to better utilize the solar panels. One estimate has the utilization factor, the time spent actually using an asset versus the time it could be used, of solar pumps at 15%. Thus, the solar panels

for a solar pump could also be viewed as assets that generate electricity for consumption in peoples' homes, not just the pumps.

So instead of sizing the amount of solar simply to meet the maximum ("peak") irrigation pumping needs, the amount of solar needed could include the electricity needs of nearby residents in planning such a microgrid. This type of microgrid design could supplement existing microgrid service offerings, such as systems offered by companies like Mera Gao Power and Husk Power, which typically size installations for four to six hours of lighting and cell phone charging (20-40 watts per household) during the evening. This strategy would enable service providers to market dual uses for the microgrid — for irrigation pumping and household consumption.

In practice, a number of challenges would still exist for those trying to build microgrid projects that use solar pumps as an anchor load. Solar panels output direct current (DC), but farmers today are more familiar with AC-based mechanized machinery. Not only would efficient DC motors for irrigation pumps need to be developed to avoid the cost of an inverter, education on utilization and maintenance of DC pumps would be critical for long-term sustainability of the machinery.

Furthermore, it will be important to optimally locate and size the solar generating assets in relation to the irrigation source and the residential electric loads. Farmland requiring irrigation may not be proximal to the homes of agricultural laborers, their families, and neighbors. Creating a network between the field and the village could complicate wiring over long distances and increase electricity losses.

With all these factors in mind, a viable business model to implement such a concept would require careful thought. In order to be financially sustainable, electricity service providers must develop creative yet equitable ways to extract value from providing electricity for residential and pumping purposes. For basic provision of electricity, i.e., four to six hours of lighting and cell phone charging, many use \$2 per month as a reasonable willingness-to-pay; that is typically the amount spent on kerosene per month per household in India. It's not yet clear how the larger loads and the additional economic generating ability of solar pumps might affect constructing a similar benchmark price.

Despite all these challenges and issues that need to be worked out, the notion of meeting residential electricity and irrigation needs simultaneously holds immense promise. To date, these initiatives have been pursued separately and have not taken advantage of solar as a common generation source. By looking at solar pumps as potential anchor loads for microgrids, key challenges in enabling both electricity access and income generation through reliable irrigation can be overcome.

Varun Mehra is a graduate student in MIT's Engineering Systems Division and a Research Fellow with the MIT Tata Center for Technology and Design.

Nancy Adams

D-Lab off-grid energy group launches solar lighting product comparison resource

For D-Lab's Eric Verploegen Phd '08, statistics are more than, well, statistics — especially when they concern the quality of life for people living in poverty. So when he read about the more than 1 billion people in the world living without reliable access to electricity, he wanted to do something about it.

He got his chance when he joined D-Lab's Scale-Ups program in early 2014 and started the Off-Grid Energy Group, which conducts work in the areas of needs assessment, technology evaluation, and market deployment.

"Over time, a solar lantern can save a household money while providing safe, higher-quality, long-lasting light," Verploegen explains. "While solar lanterns are available throughout the developing world," he continues, "selecting the right solar lantern is critical where the investment may equal as much as a third of a family's monthly income."

It's an investment that many in the developing world are willing to make. A reliable solar lantern can be life-changing where people otherwise rely on expensive and toxic kerosene lamps — or forgo the luxury of light after sundown. Solar lanterns enable children to study into the evening, make household chores easier at the end of the day, reduce the risks of moving around outside after dark to tend to animals or go to the toilet, enhance social time with friends and family, and many models enable families to charge cell phones.

However, with hundreds of solar lighting products on the market in the developing world, it's not easy to compare the cost and quality of multiple products in order to make the best possible purchasing decision.

Now, with the help of a new online resource, Solar Lighting Product Comparison from the D-Lab Off-Grid Energy Group, consumers and distributors can compare more than 55 products ranging from solar lanterns used for basic lighting needs to solar power and lighting systems with the capability to power appliances such as mobile phones, radios, fans, and TVs, in addition to providing lighting.

"There are many organizations and programs working to increase access to solar energy products where they are most needed," Verploegen says. "Our job was to figure out what was missing."

Verploegen was intrigued by the work coming out of MIT's Comprehensive Initiative on Technology Evaluation (CITE). CITE has developed and piloted a methodology for evaluating products intended for the developing world focusing on the dimensions of suitability, scalability, and sustainability.

Their first study of solar lanterns available in Uganda, published in early 2015, included a comparative chart of solar lanterns available in Uganda. "CITE is pioneering a rigorous methodology for evaluation," comments Verploegen. "What D-Lab's Off-Grid Energy wanted to bring to the table was the rapid dissemination of comparable product

specifications linked to geographically organized distributor contact information around the world."

Verploegen didn't have to start from scratch. Inspired by CITE's Uganda Solar Lantern study, Verploegen researched the availability of solar lighting product information that was global in scale. He found Lighting Global, the World Bank Group platform, which has been providing basic information on solar lighting products that meet minimum quality standards since 2009 and continuously updates their database.

In developing this resource, D-Lab's Off-Grid Energy Group working from Lighting Global's database (in fact, they will include only products that have passed Lighting Global's quality assurance standards) and takes it a step further. Working with Eric Ferraiuolo, a volunteer software engineer, and Chitti Desai, an undergraduate intern from Wellesley College, Verploegen built a database that combines technical specifications of high-quality solar lighting products and information on distributors that sell products in various countries throughout the developing world.

"The system provides country-specific information sheets with key technical specifications of solar lighting products in a table format that makes comparison easy, and contact information for distributors that sell the products locally," Verploegen says. The database includes information on more than 100 distributors operating in 47 countries across Africa, Latin America, Asia and Oceania, allowing consumers to determine which products are available and where they can purchase them.

Additionally, a full product comparison table is set up in a straightforward, sortable Google sheet that provides detailed information on model, manufacturer, price (in U.S. dollars), lighting output, settings and runtime, battery and solar panel specifications, features and accessories, as well as information on the warranty and certifications for some 50 products.

"It is exciting to see our colleagues at D-Lab building upon CITE's approach to develop and release such an important resource for people

living in poverty," comments Joanne Mathias, associate director of CITE. "Access to information such as this is invaluable if technology is to truly improve lives and livelihoods in the developing world."

Verploegen has a South Sudanese friend now living in the Boston-area who will be visiting his home country soon. "Phillip knows I've been studying solar lanterns," Verploegen says, "and he asked me how to advise friends and family on which solar lanterns to buy. Now I can point him to this resource. His friends can click on South Sudan and find a review of products and distributors as well as detailed technical specifications in the full comparative chart." He continues, "If the product they want is not available in South Sudan, they can use the database to look at for products available in neighboring countries such as Uganda, Kenya, and Ethiopia, and even set up businesses to import the products to their communities."

"Our goal is getting the right product into the hands of the people who need solar lighting the most and increasing the odds that investments made in these products serve the purchasers well," Verploegen says. "We not only want to increase access to energy for some of the people that make up that one billion currently without, we want to help increase the odds that they'll get access to the right products for them."

The Solar Lighting Product Comparison from the D-Lab Scale-Ups Off-Grid Energy Group is part of a larger effort to develop tools and resources for increasing energy access for off-grid communities in the developing world. In addition to the Solar Lighting Product Comparison project, the group is developing resources for needs and market assessments, as well as a selection of distribution strategies for energy products.

Nancy Adams is Communications Administrator at MIT D-Lab.

Mike Hower

Grid or no grid, efficiency is key to powering the global South

Global demand for electricity is expected to grow by 56 percent between 2010 and 2040. Most of this increase will come from developing countries, often referred to as the global South, where strong economic growth is driving demand.

For the quantitative minds among us, that's an anticipated uptick from 524 quadrillion Btu to 820 quadrillion Btu, according to the U.S. Energy Information Administration.

But energy growth isn't the same as energy access, and the latter could continue to be a problem in the world's poorest regions.

In many off-grid regions, small-scale solar and wind technologies, as well as microgrids, are helping to bring electricity to entire swathes of humanity. But energy efficiency could be the key to making these technologies viable in remote regions, accelerating efforts to make modern energy services available to those who need it most, according to a recent report by the World Bank.

A total of about 1.1 billion people around the world don't have access to electricity, according to the World Bank, and 2.9 billion live without modern fuels for cooking and heating. This effectively bars them from the modern economy, and also creates widespread social and environmental problems.

In a world without electricity, productive hours for working adults are limited to daylight hours, and these jobs typically are low-tech and low-

paying. Likewise, children can't study at home after dark, which puts a damper on education. I witnessed this first-hand late last year during a trip to Mathare, a slum in Nairobi, Kenya.

Simply put, nearly everything in the modern global economy relies on electricity to function.

Commercial buildings, industrial facilities and, of course, homes all require electricity to work in the 21st century. The Internet, which forms the digital infrastructure of e-commerce, relies on physical infrastructure capable of generating and delivering copious amounts of energy to data centers.

The energy efficiency-access nexus

The new World Bank report mulling the role of efficiency in global energy development, EA + EE: Enhancing the World Bank's Energy Access Investments Through Energy Efficiency, identifies a nexus between energy efficiency and energy access by examining eight recent projects.

It also recommends some ways energy efficiency measures can amplify the impact of future projects that aim to achieve universal energy access.

Technology such as home solar systems, small wind turbines and renewable mini- and micro-grids can help generate power for people living off the grid. But greater energy efficiency means there is more electricity to deliver to a larger number of households and businesses, the report said.

In Bangladesh, for example, efficient LEDs com-

bined with the easy-to-use solar kits resulted in longer, more reliable periods of electricity supply at a much lower cost, the report said. Some 18.5 million Bangladeshis have been able to adopt the combination to power their homes.

In another development project, the World Bank sought to expand access to rural populations in Bolivia, which has one of the highest poverty rates and lowest rural electrification rates in Latin America — due to its small population being spread thinly across inaccessible mountainous terrain.

The project succeeded in extending off-grid access by installing over 7,000 solar home systems and over 5,000 Pico PV systems in rural households, schools, clinics and small businesses. However, the World Bank struggled with selling the idea of using LEDs and efficient appliances with the new systems because it's tough to build markets for these products in such remote areas, the report said.

Private capital and closing the energy gap

Making reliable, affordable electricity available to everyone in the world by 2030 was one of the goals that came out of the U.N.'s 2012 Conference on Sustainable Development in Rio de Janeiro.

Later, the Sustainable Energy for All (SE4All) initiative was formed to make it happen. It has rallied the public sector, private sector and civil society around three big objectives: ensuring universal access to modern-energy services; doubling the rate of improvement in energy efficiency; and

doubling the share of renewable energy in the global-energy mix.

"Such accelerated action will require serious investment," Anita Marangoly George, senior director of the World Bank's Global Practice on Energy and Extractive Industries, wrote in a recent blog post. "Already, SE4All has helped lay out a realistic financing plan with inputs from leading financiers who are part of the partnership."

The world needs to triple its investment in sustainable energy infrastructure per year, from around \$400 billion now to \$1.25 trillion by 2030, the World Bank estimates.

"We believe that this level of private capital is available, but investors tend to be wary to enter new markets that they regard as risky," Marangoly George wrote.

Development partners such as the World Bank are working to make these investments more attractive to the private sector by reducing risk and building strong, reliable energy institutions, Marangoly George said.

It also means laying out energy investment prospectuses to attract private capital and identifying a range of financial tools that give investors the confidence they need.

Mike Hower, Senior Writer GreenBiz Group.

Robert Walton

Honey, I shrunk the grids: The emergence of 'nanogrids'

First it was just the grid. Then we had microgrids. And now, it seems an even smaller type of energy system – the nanogrid – is poised for significant growth and could potentially challenge utilities to change the way they do business.

New research from consultancy Navigant Research predicts the worldwide market for nanogrids including solar photovoltaic generation and energy storage will rise at a startling clip over the next decade, from \$1.2 billion in 2015 to \$23.1 billion in 2024. Compare that to the firm's prediction last year for microgrid growth (from \$2.4 billion annually in 2014 to \$5.8 billion in 2023) and the larger nanogrid market, where it sees global vendor revenue growing from \$37.8 billion in 2014 to \$59.5 billion in 2023.

Navigant principal research analyst Peter Asmus said declining costs of storage and solar power, along with "an explosion of investment in creating a new distributed energy resource landscape," are helping the segment grow rapidly. That growth could upend the utility's business model.

"Generally speaking, they could represent a threat to utilities in some ways, just like a microgrid is also a threat," Asmus said.

Navigant defines nanogrids as a grid-connected system with a capacity of 100 KW or less, or a 5 KW off-grid system. Typically this is a single load, perhaps a residential home or commercial building. Their small size and configurations can mean they face fewer regulatory hurdles, and with interest

growing in the aggregation and integration of distributed resources the systems could grow quickly and cause problems for the traditional utility business model.

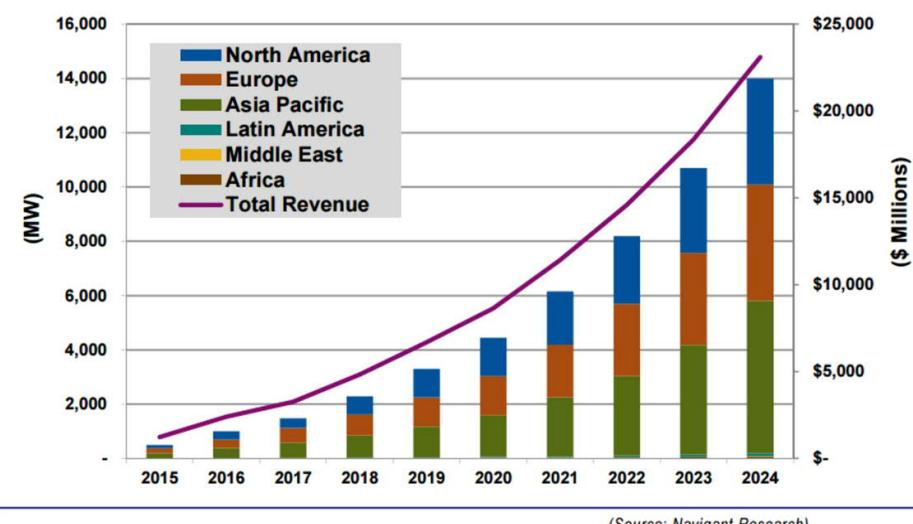
But in the last few years, more utilities are developing microgrids themselves, Asmus noted, which represents not just a strategy change but the potential to integrate more nanogrids down the line.

Duke Energy, San Diego Gas & Electric, and Central Hudson -- along with many other utilities -- have all been working to integrate microgrids into their systems. And Asmus said that while nanogrids focus on smaller loads, the new wave of microgrids, which can help integrate their younger siblings, are growing in size and are now used for large-scale applications. The SDG&E microgrid, for instance, is a 100 MW system that utilizes solar energy and powers an entire community.

"That's a major shift. When I started this research in 2009, by far the vast majority of microgrids connected to the grid were not utilities, and in fact utilities were trying to stop microgrids," Asmus said. "And in some cases that's still true."

But with every home a potential nanogrid, and regulations allowing them to be installed with little fuss, widespread aggregation could add significant distributed resources to a utility's portfolio. Whether it's the utility doing the aggregating or a third party, Asmus said power providers will need to make changes in the way they operate.

Chart 1.1 Total Solar PV plus Energy Storage Nanogrid Capacity and Revenue by Region, World Markets: 2015-2024



(Source: Navigant Research)

Size gives nanogrids a regulatory edge

While nanogrids and microgrids are similar, they are conceptually different in a way that allows the smaller systems to be developed quickly.

"Nanogrids don't violate utility franchise rights," Asmus said. "They basically deal with a single building, so you can develop a nanogrid without a lot of the regulatory issues."

In New York, where the state is trying to incorporate more microgrids into its grid system, Asmus said dealing with mixed customer classes has made it difficult to build systems. "That's very complicated from a regulatory point of view," he said. "The nanogrid can be done more immediately."

"They're smaller in capacity, but in a sense they could be viewed as a greater threat," he said. "At some point they could challenge utilities, but I also think the whole 'utility death spiral' has been blown out of proportion. The utilities are not going to die because of these systems, they're just going to have to figure out how to change the business model."

Falling costs drive growth, but aggregation could pack bigger punch

The traditional narrative holds that batteries are

the weak link in grid applications, usually for their limited lifespans and the costs associated with the technology. But bolstered by renewed interest, with development help from the auto sector, lithium ion batteries are changing that notion. The new batteries are good at cycling and providing services, but "are not ideal for long term storage -- they're kind of a battery that's in the middle, in terms of applications," Asmus said.

"The decline of [the price] of lithium batteries ... is what is really underpinning this market," he said. "Although long-term, it's not going to be just lithium ion. We're always going to have a diversity of batteries."

As storage is more frequently paired with home solar installations, it will open up a large potential for aggregation of residential storage, Asmus said. In Germany, third parties are already aggregating homes, bringing together 1,000 systems, for instance, to create a significant controllable load.

"They're each a nanogrid but they become a part of a virtual utility that can grow and contract depending on the needs of the market," Asmus said. "The smaller systems will require intermediaries, at some point, whether those are aggregators, microgrids or virtual power plants. These are all

structured to bridge between retail resources and wholesale resources."

As more distributed resources are added to the grid, projects and concepts will stack onto one another. For example, using microgrids to integrate renewable power from nanogrids. "As all these resources come onto the system, one of the ways to make it work is to aggregate smaller systems," Asmus said. "These are bridges to make these smaller resources more digestible by the larger system."

"I don't think we're ever going to be all distributed resources -- we'll always have some of the larger stuff -- but a larger and larger portion of the power will be coming from these distributed resources."

Robert Walton is Contributing Editor at utility Dive.

Solar Novus Today

Trojan Battery introduces "Farm from a Box" off-grid solution

Trojan Battery Co., LLC, a specialist in deep-cycle batteries, provides the energy storage solution for the "Farm from a Box" sustainable micro farming system. The "Farm from a Box" system will feature four Trojan AGM batteries which will serve as the system's energy storage solution.

"Adam," the first "Farm from a Box" solution will debut with a ribbon cutting ceremony at 4 p.m. today, 25 September, at Shone Farm, 7450 Steve Olson Ln., Forestville California in Sonoma County. Follow the festivities on Facebook at Farm from a Box.

Housed in a modified shipping container, "Farm from a Box" is a turnkey micro farming system that comes with all of the core components and tools required for off-grid food production in remote or rural locations. Designed to be a versatile, transportable, sustainable food production solution, the "Farm from a Box" components can be adapted to a range of conditions, making this the optimal plug-in for a wide variety of agricultural technologies.

"Farm from a Box is the 'Swiss-Army knife' of sustainable farming," said Brandi DeCarli, Farm from a Box founding partner. "Based on extensive field research, we found that rural communities often lack the resources and infrastructure needed to access nutritious food. We developed a toolkit that contains all of the core components needed to grow your own food, on a two acre plot of land,

without the need for an existing grid. Imagine the good it can do by growing local, organic food for a school, or helping jumpstart food production after a disaster. 'Farm from a Box' enables and empowers communities to provide for themselves."

Farm from a Box is ideal for any application that requires a comprehensive system that enables sustained local food production, without need for an existing grid; from disaster response and humanitarian aid, to schools and community cooperatives. While each unit can be customized to fit the needs of the end user and location, the core components include:

- Solar-powered pump and drip irrigation
- Basic farming tools
- Water purification system
- High-efficiency solar panels
- Trojan Battery bank for energy storage
- High-efficiency LED lighting
- ICT and data mapping
- Mobile charging area
- Secured storage

"The innovative concept offered by 'Farm from a Box' is a terrific example of how to empower communities in developing regions to provide for themselves," said Bryan Godber, senior vice president of global market development for Trojan Battery. "Trojan is pleased to play a vital part in the 'Farm from a Box' worthwhile mission to help developing regions establish a stable infrastructure for sustainable food production."

About Farm from a Box

Farm From A Box is a for-profit social enterprise that uses a market-based approach to bring struggling communities the farming capabilities they need to grow their own food and generate an income. Built from a modified shipping container, each Farm from A Box unit contains a complete ecosystem of technologies required to enhance agricultural productivity. Components range from

renewable power and irrigation, to information and communications technology.

Solar Novus Today brings daily blogs, solar research and original feature articles for the worldwide solar industry.

Countries

Jeremy Higgs

Pakistan: Light in the darkness

The US-Pakistan Clean Energy Partnership, which was recently announced, should be recognised for the estimated impact that it will make on 30 million people by adding at least 3,000MW to the electricity grid. Pakistan is in an energy crisis — one that adversely impacts its economy and costs businesses up to 34 per cent of their annual revenue, according to the World Bank's Doing Business 2016 report. Anything that can be done to address this state of affairs should be celebrated.

But do you know who aren't celebrating this partnership? The estimated 70 million people of Pakistan who aren't connected to the electricity grid, and aren't likely to receive its benefits in their lifetime. In fact, without electricity to power a phone, radio or TV, it's likely that they've not even heard of the partnership.

The Pakistan government has sadly been silent on its plan to bring this large proportion of the population into the 20th (let alone the 21st) century. Instead, it's focused on big-ticket power plants, both dirty and renewable, that sit well with the voting public. This is an extremely short-term view. Every day, this population spends money on inferior alternatives, limiting its economic contribution. According to the IFC Pakistan Off-grid Lighting Consumer Perceptions report, the off-grid population spends \$1.2 billion every year on poor alternatives, such as kerosene and battery-powered torches. But these alternatives aren't adequate. A child can't study by the light of a kerosene lamp, nor can a businessman keep his shop open after sunset.

Across the Atlantic Ocean, we see a different

story. Hundreds of thousands of households in East Africa, in the short span of a few years, have gained access to modern energy through pre-paid solar systems from private sector companies, such as M-KOPA, Off-Grid: Electric and BBOXX. Mobisol, a German company operating in Rwanda and Tanzania, announced that it has sold solar systems to over 30,000 households in 2.5 years, amounting to over 3MW in solar generation capacity. Having demonstrated feasibility, African governments are now supporting such companies in their endeavours, such as the Tanzanian government pledging in 2015 to light one million off-grid homes by 2017. In Bangladesh, the government and development institutions have implemented the IDCOL programme to unlock consumer financing. In 2.5 years, the programme has gone on to facilitate electricity access for over 3.6 million people.

In Pakistan, the story is bleak in comparison. The social business that I co-founded, EcoEnergyFinance, is one of a handful of players that reach deep into off-grid locations to sell and service solar energy solutions. We have found that a lack of affordability, availability and service infrastructure prevent people from accessing such solutions, and this is reflected as well in the IFC report. The government can address this in the following ways. Firstly, by providing financial mechanisms that will unlock consumer financing of solar energy solutions by the private sector.

Secondly, by ensuring that all solar panels and accessories imported into Pakistan are of high quality and certified by a programme like Lighting Global. And lastly by providing flexible funding to

promote innovative and entrepreneurial solutions to the off-grid challenge.

The private sector is ready to step in and meet the growing needs of the 70 million people that are off-grid. With the support of the government, our progress can be accelerated, leading to a more prosperous Pakistan.

Jeremy Higgs is the co-founder and director of operation of EcoEnergyFinance, a venture aiming to provide affordable solar energy to rural Pakistan.

Jonathan Pearlman

Half of Australian homes to adopt solar power and move 'off grid' from 2018

Australians will be able to use solar panels and batteries to cheaply produce and store electricity within three years, in a "dramatic" development that is expected to revolutionise the nation's power generation.

A report by The Climate Council, a non-government organisation, found that improvements in battery technology could make home-made electricity cheaper than buying it within three years and could allow half of the nation to start moving "off the grid".

Australia already has the highest rate of household solar panel use in the world. About 15 per cent of homes have panels installed, roughly double the rate in Belgium, which is believed to have the second highest usage.

The panels have led to big electricity savings for the 1.4 million householders who have installed them, but only about 500 people currently have batteries to store the solar power.

The Climate Council said the cost of producing lithium-ion batteries will fall "dramatically" in the coming years and that each battery's capacity will grow 50-fold within a decade.

It said a household which spent £5,000 on a battery would make back the money within ten

years and that, at such a cost, about half the nation could start adopting solar panels with battery systems.

"By 2018, going off-grid by installing battery storage could be cost-competitive with staying connected as the price of battery storage falls and grid electricity remains expensive," the council's report said.

"Together with rooftop solar, battery storage presents an opportunity for Australian households to use a much greater proportion of the solar photovoltaic electricity they generate and minimise the need to purchase expensive electricity from the grid."

The United States firm Tesla is planning to release a lithium ion battery which is expected to cost less than £2,600 and will be available in Australia – one of the first foreign markets to receive it – by the end of the year.

Jonathan Pearlman is journalist in Sydney.

Anand Upadhyay

Next big thing in Bangladesh — solar irrigation pumps

If you have any interest in the off grid solar space, you would certainly be aware of Bangladesh's success in promoting solar home systems.

At the last count, the country had installed over 3.8 million solar home systems since 2003. Scattered across the country, these systems generate a total of 135 MW of electricity and benefit over 13 million people. And Infrastructure Development Company Limited (IDCOL), which started the SHS program in 2003, has no plans to slow down, and is looking to finance 6 million of the systems by 2017. The organization is a non-bank financial institution created by the Government of Bangladesh to finance infrastructure and renewable energy projects in the country.

IDCOL receives its credit and grant support from a host of multilateral and bilateral agencies, and operates through its network of 47 partner organizations who sell solar home systems to rural customers. IDCOL provides competitive loans to its partners (small solar home systems which are used by small households may also receive grants) to mitigate the burden of financing. Apart from this, the partner organisations also receive technical assistance, and in turn are responsible for installing the solar home systems, extending credit to the end users and ensuring after sales services. For their services, the partner organisations receive monthly payments from the customers.

The key pillars for the success of the solar home system program, as against similar attempts in other countries, has been the integrated mecha-

nism for easy financing, and after sales services to take care of any technical faults.

With their solar home system program now on autopilot mode, IDCOL now wants to focus its efforts to promote solar pumps across Bangladesh.

Bangladesh has good solar resources, with high availability during the peak irrigation season. As a result, solar pumping of water for irrigation presents an innovative and environment-friendly solution for its largely agro-based economy.

The country has about 1.71 million irrigation pumps, of which 83% run on diesel. The remaining 17 % are electricity-operated. The demand for irrigation is concentrated during February-March. So much so that during the peak irrigation period 2000 MW of power demand is solely required for running the electric pumps.

The diesel-run irrigation pumps on the other end consume more than half a million tons of diesel. This comes at a great cost to the exchequer as Bangladesh imports 100% of its diesel requirement which is then distributed to the users at a highly subsidized price.

To leverage its success in the solar home system programs, IDCOL has set itself a target to finance 1,550 solar irrigation pumps by 2017 and 50,000 by 2025. The World Bank, KfW, GPOBA, JICA, USAID, ADB, and Bangladesh Climate Change Resilience Fund (BCCRF) are all supporting this initiative.

To begin with, the program is intended to provide irrigation facilities to off-grid areas and thereby reduce dependency on fossil fuel. As per Mr.

Enamul Karim Pavel who is the Head of Renewable Energy at IDCOL, 100 solar irrigation pumps are in operation and another 500 are in the pipeline.

On the basis of life cycle costs, solar irrigation pumps are much more attractive compared to diesel pumps. In addition to this, PV pumping systems allow low operating cost, unattended operation, low maintenance, easy installation, and long life. These advantages are especially important in remote rural areas which are yet to be grid connected. My personal favorite feature of solar pumps is that you don't really need a battery to store the electrical energy, and can really have a system which would run for 15 to 20 years. Most of the installations use a raised tank to store the pumped water which is then used to irrigate the fields.

Easy availability of water for irrigation will help to both increase agricultural productivity, as well as save valuable foreign exchange. The project also contributes to the Government of Bangladesh's climate change adaptation vision.

Being a new product in the market, solar pumps face a lot of challenges.

The initial high cost is the biggest barrier to adoption. To overcome this, IDCOL has been experimenting with both a 'water as a service' (community) model and 'individually owned small size pumps' model.

To accelerate the number of installations, a large part of the capital cost is being provided as a combination of grant and soft loan. IDCOL is providing financial support to solar irrigation projects based on a debt, equity and grant ratio of 30:20:50. As the uptake of solar pumps increases, the aid amount will be gradually reduced.

In fact, IDCOL has asked the government to stop connecting new electric irrigation pumps to the grid.

Lack of information about solar pumps among the potential users is another major issue. IDCOL has been training its POs to promote solar pumps, both by means of advertising them among farmers and by installing and maintaining them as showcase pilot projects.

To increase the ROI from solar pumps, IDCOL is exploring other productive uses during non-solar hours such as – husking, grinding, threshing, oil press etc. and also to supply electricity to households.

Anand Upadhyay is an Associate Fellow with The Energy and Resources Institute (TERI, New Delhi).

Phindiwe Nkosi

Kenya's Maasai women jump-start Africa's solar revolution

As a result of work undertaken by the Women and Entrepreneurship in Renewable Energy Project (WEREP), an initiative by Green Energy Africa, a large group of Maasai women trained in solar panel installation is now able to bring reliable power to the people of Magadi, a village in Kenya's Kajiado County.

The group of about 200 women are making headlines for ushering in solar transformation to somewhat inaccessible destinations, by acquiring skills, buying discounted solar products from renewable energy developer Green Energy Africa and illuminating the lives of their communities and families. The women – who also use simple, available means which include donkeys – have been applauded by people across Africa for rising to the occasion, solving societal problems and showing that women are also capable of entering the male dominated world of science and technology.

"South Africa and Africa at large are struggling with the challenges of renewable energy, shocking unemployment figures, lack of sustainable youth development and many problems. Our society, faith and culture have made a woman not to be viewed as a 360 degree type of thing..."

These Maasai women have started a solar revolution for the people of Africa. They are exemplary and disprove wrong misconceptions," said Nawaal Nolwazi Mdluli, Founding Editor of Essays of Africa, a women orientated lifestyle magazine that celebrates exceptional African women's journeys.

According to Mdluli, women are able to come up with complex solutions and as individuals and businesses, the question that should be asked is what can be done to build on the steps taken by women such as these solar revolutionaries.

"The question we must all ask is what can I do? How can I find these women to do in South Africa what they have done in Kenya? How can I get involved? All it needs is balls, boobs and brains because women are the only 360-degree species that can give life, carry life and give birth without being crippled by pain, but go on to nurture that life," continued Mdluli.

According to Mdluli, who is also the CEO of Kwenta Media, women bury, dig graves, carry guns, build houses, walk in mine trenches and can pretty much do anything. There is only one thing, she asserts, that is lacking in women:

"The only thing I don't have that a man does is sperm – and I can go buy it and put it inside of me and make a baby. Even if a man were to buy my egg, can he put it inside of his body and do that? Give anything to a woman. These women must be celebrated and used as banners to light up Africa and other women," said Mdluli.

Agreeing with the notion that the advancement of women could indeed help communities and that more spotlight needs to be given to such initiatives was Kelley Boss, Kenyan Journalist News Anchor and former Radio Host.

"Yes, Kenyan women can help better the other

parts of Africa, particularly with so many trading blocks in place. It is easier for women in Kenya to link with others to share ideas and network across Africa," elaborated Boss.

Boss affirms that it is no longer a rare act to see African women entering formerly male dominated science and technology platform because society is starting to recognize the values of gender equality. Employers, corporate and government no longer judge your gender, but ability.

"The evolving roles of African women is not an isolated case for Kenya only because we now have female presidents in Africa. A lot more can and must be done to honor leading women. For example, I was brought up in Kitale, a small town in Kenya where electricity was a story for many years. Despite the shortcomings, my mom encouraged me to work hard," said Boss while reiterating the

significant role that women play in Kenyan society and across Africa.

"I still visit Magadi, Kakamega to Kisumu [where electricity is scarce] and try and tell their story so that someone can come to their rescue, but all in all the saying is true: 'empower a woman and feed a society'. Even though progress is minimal, it is encouraging to see that society is beginning to take note of the importance of educating the girl child," concludes Boss.

Phindiwe Nkosi is journalist, travel writer, and book author.

Rahul Shah

Decentralised energy market in rural Cambodia - A site visit to Kamworks

Cambodia is a country with a population of over 15 million. As per GSMA estimates, 99% of its population is covered by GSM networks. On the other hand, just over a third of the population has access to grid electricity. GSMA estimates that the energy addressable market (people covered by GSM networks but not served by the grid) in 2013 was 9.6 million. The statistics strongly suggest a large opportunity for solar home systems (SHSs).

Last year, the GSMA awarded a grant to Kamworks to test an innovative rental or sales model for SHSs. I visited Kamworks earlier this year to learn more about the environment they operate in and better understand the market opportunity for SHSs, especially pay-as-you-go (PAYG) SHSs which rely on good mobile coverage and mobile money penetration.

A site visit – how Kamworks work

Kamworks installs a demo system in a house where that family can use the system for a few days and neighbours can share the experience. A Kamworks sales agent does a presentation at the home of the host family and then follows up with people who register their interest. A credit check is done by the financing party (could be an MFI or Kamworks itself). Observing the sales presentation and visiting several homes gave me some insights specific to the Cambodian market.

Energy in Cambodia versus East Africa

In most East African markets, small SHSs are extremely popular as a superior alternative to dirty fuels for lighting. These systems often the first to bring electricity to homes. The situation in Cambodia is radically different. Many homes use 50Ah automotive batteries, charged by someone running a diesel generator, to power their homes. This solution is unwieldy (the batteries are very heavy) and means the home is without power when a battery is being charged. However, given that potential customers of SHSs have already experienced electricity in the same form that a solar system would provide, there is less aspirational value for solar than in East Africa. Instead, the market for energy is largely commoditized.

Appliances

In many homes, people have bought inverters to drive commonly available AC appliances. It is not uncommon for people to own multiple batteries so they can drive several appliances. Virtually all homes I visited already had multiple lights and fans. One home had a 1.2kVA inverter and a 42-inch Samsung LCD TV.

Below is a photo of a typical appliance that supports DVD playback and playback from pen drive over USB. This device costs \$20-30 and a fully charged car battery will power it for about four hours.

Mobile Money

Mobile money is primarily used for remittances in Cambodia. People are unfamiliar with payments for services through mobile money. In fact, even agents need to be trained to accept payments for bills. The mobile money footprint, although advancing steadily to rural Cambodia, is still far from ubiquitous like it is in East Africa.

What is the opportunity?

For a household used to powering its home with a 50Ah battery to drive several loads, a small pay-as-you-go (PAYG) SHS below 10W capacity is simply not enough for this segment. The minimum SHS size would have to be in the 50W range. For a system this size, availability of financing can really bring down the barrier to ownership. And we have seen mobile-enabled PAYG systems are not only technically feasible, but also financially viable in other markets.

The next question is more important – what problem does this system solve?

- Convenience? Not having to lug around heavy batteries is a nice to have. But some enterprising charging services even offer to pick up and deliver.
- No “outage”? For a home with a single battery, there is an “outage” when the battery is being

charged. However, this is typically during the day time when the system is least used.

- Safety? Open connections to battery leads can present a risk. An SHS could be made much safer by enclosing the battery.
- More energy? Automotive batteries degrade quickly when they are over-charged. Most charging service providers stop charging a battery only when it is hot which means it is damaged each time it is charged. SHS batteries with charge controllers would degrade more slowly.

It remains to be seen whether any of the above is compelling enough for people to invest money in a large SHS. Meanwhile, it is abundantly clear that appliances are very popular even in rural Cambodia which would be considered “energy starved” if we went only by statistics. Perhaps a PAYG SHS with remote monitoring can be an anchor to understanding consumption and thus used to upsell appliances.

Rahul Shah is the Asia Project Manager for the Mobile for Development Utilities Programme at GSMA.

Patricia Levi and Yael Borofsky

Uncertainty in grid expansion and grid supply: A case study in Bihar, India

India's issues supplying reliable electricity to its population are well known and sometimes high profile. Just think back to the lack of adequate generation that contributed to the massive blackout in 2012. The new government under Prime Minister Narendra Modi has been promising rapid extension of the electric grid and solar power to provide electricity to every home in India. Such achievements would provide incredible benefits for states like Bihar, where only about 16% of households had electricity access in 2011, one of the lowest electrification rates in the country (Government of India 2012). Despite these promising announcements, we observed a tremendous range of opinions about the likelihood of the promised grid extension in Bihar on a recent trip to India. This diversity of opinion has significant implications for potential off-grid solutions, especially in the context of the poor performance of Bihar's current grid.

In January, we spoke with a number of people in India across the power sector, all of whom had a different take on how likely grid extension is for Bihar. Predictions about the actual timing of grid extension to all of Bihar ranged from two years from some officials in Bihar, to 'several generations, maybe never,' from those in major cities outside the state. Aside from political ties to the ruling party, there are a number of possible explanations for such varying expectations about the future of the grid in Bihar. Regardless of the caus-

es, though, such predictions have the potential to influence future plans for off-grid electrification solutions, which have been gaining momentum among NGOs and entrepreneurs throughout India and the developing world.

Sometimes it might make more sense to invest in off-grid systems

We went to Bihar with an interest in how off-grid solutions like micro-grids and solar home systems could prove valuable in un-electrified parts of the state. Such systems, while not typically able to support the kind of electric loads that a grid connection might, nonetheless offer some level of electricity access years before rural Indians might otherwise receive a grid connection. But the benefits of investing in such systems are highly dependent on the expected timing of grid extension; if a rural Indian village has no electricity and will not receive a grid connection in the next 5 years, it might make more sense to invest in a solar home system, for example, whereas it might not if you expect the grid to arrive in one or two years.

Past trends in electrification in Bihar and conversations with other stakeholders suggested an environment in which the uncertainty of plans for grid extension makes off-grid, often solar-based systems, seem attractive, at least in some areas. However, almost everyone we interacted with who was connected with the power industry in Bihar insisted that off-grid electrification was only useful

for a few very remote areas because all other places would receive a grid connection in the next two years. Local officials in the power industry also predicted that rural inhabitants of the state would not welcome solar-based power, because they perceive it to be inferior to a grid extension. We couldn't vet the veracity of these statements. They likely have some kernel of truth, but it is important to keep in mind that there are also many plausible motivations for these officials to insist that rapid grid extension is more likely than it actually is.

Poor reliability of current grid

Although individuals in the Bihar power sector are bullish on the likelihood of grid expansion, the possibility of that expansion and the benefits it would create are additionally thrown into question by the poor reliability in Bihar's current grid. We visited a substation in Bihar to obtain data about the reliability of the network. For rural electricity distribution lines, reliability was incredibly poor especially during peak hours. A sample of data we collected for one rural line from the substation revealed that electricity was only available for ~30% of the time during evening hours (6pm to 8pm), when demand is at its peak. These numbers support previous reports of spotty grid reliability in the region; Oda and Tsujita (2011) surveyed villages in Bihar that had electricity access and found that the hours of available electricity were on average only 6.3 hours in good months and 1.3 hours in bad ones. Harish et al. (2014) estimate that only 66% of peak demand is met in rural areas of Bihar.

Could off-grid supply be a more worthwhile investment than grid extension?

This poor level of service to rural areas raises the question: Even if the grid were to expand throughout Bihar, would it provide worthwhile benefits, in terms of high quality electricity, to the people living there? Adding a large amount of new load to the grid is virtually guaranteed to increase outages, especially at peak times, if large invest-

ments in generation as well as the distribution infrastructure of the existing grid are not made. Indeed, although lack of supply is frequently cited as the cause of outages in India, the outages we observed in rural electricity lines were not caused by lack of supply alone — the transmission line feeding the substation had dramatically fewer outages. Instead, the culprit is anemic and under-maintained infrastructure that is not sufficient to meet current load, let alone an expanded set of consumers. Such deficits do not bode well for the prospect of grid extension, and reinforce the importance of figuring out whether off-grid supply could be a more worthwhile investment in many places than grid extension, at least in the near term.

Sources for this article:

- Government of India, *Census of India 2011*, Ministry of Home Affairs, Government of India, New Delhi. District Tables - HH-7: Households by Main Source of Lighting. (2012) <http://www.censusindia.gov.in/2011census/hlo/District_Tables/Disstt_table/10/HH2507-1000CRCD.pdf>
- Harish, Santosh M., Granger M. Morgan, and Eswaran Subrahmanian, "When Does Unreliable Grid Supply Become Unacceptable Policy? Costs of Power Supply and Outages in Rural India," *Energy Policy*, 68 (2014), 158–69 <<http://dx.doi.org/10.1016/j.enpol.2014.01.037>>
- Oda, Hisaya, and Yuko Tsujita, "The Determinants of Rural Electrification: The Case of Bihar, India," *Energy Policy*, 39 (2011), 3086–95 <http://dx.doi.org/10.1016/j.enpol.2011.02.014>

Patricia Levi and Yael Borofsky are graduate students and researchers at Massachusetts Institute of Technology.

Yann Doignon

Lighting up the future in Bangladesh

Night falls in Dhaka. Commercial streets glow with lights and the neon-lit stores and restaurants are abuzz with shoppers enjoying a break from Ramadan. This is a great visual spectacle punctuated by the incessant honking of colorful rickshaws.

But the reality is different right outside the capital. Sunset brings life to a halt in rural areas as about 60 percent of rural households do not have access to grid electricity. Kerosene lamps and battery-powered torches are widespread yet limited alternatives, their dim light offering limited options for cooking, reading or doing homework.

It is a sweltering hot day when our team sets out to visit a household of 14 in the village of Pachua, a two-hour drive from Dhaka. Around 80% of the villagers have benefited from the solar panel systems to access electricity. The Rural Electrification and Renewable Energy Development Project (RERED), supports installation of solar home systems and aims to increase access to clean energy in rural Bangladesh.

We're accompanied by Nazmul Haque Faisal from IDCOL, a government-owned financing institution, which implements the program. "This is the fastest-growing solar home system in the world," Faisal says enthusiastically, "and with 40,000-50,000 new installations per month, the project is in high demand."

We've now reached our destination and Monjil Mian welcomes us to his house, which he shares with 13 other members of his family, including his brothers, two of them currently away for extended

work stints in Saudi Arabia. The family purchased their first solar panel 8 years ago and added a second one later on. The closest electricity grid system is 4 km away. "We used to live in the dark" Monjil says and "we had to go to the nearest village, 4.5 km from here to recharge our mobile phones and torch lamps. It was a waste of time and money and we had to pay 10 takas for each device."

I ask how the solar panels improved their lives. Safety is a main concern for the family. One advantage of the solar system is that it can store energy in a rechargeable battery and a household can operate 3-4 lights and a television set for at least 4 hours a day—or later during the night. The family switches on their backyard light as soon as the sun sets to repel thieves and burglars from entering their property. Talking about safety, the old smoky kerosene lamps were also a hazard interjects Nasima, Monjil's sister in law, and she recounts the story of villagers whose mosquito nets caught on fire in pre-electricity days.

The conversation turns to the remittances sent from Saudi Arabia by Monjil's brothers. Their money has helped pay for the solar system and the family uses mobile banking to complete financial transfers. The whole process is now much easier and can be done at home on the fully-charged phones, thus sparing the family a trip to the nearest village.

Nasima's son, Monirul, fetches the family's latest acquisition, a brand new laptop. He's an 11th grade student at the local school and uses the computer for increasing his typing skills. "I read,

and write, and practice my typing" he says. "Before we had the solar panels, everything was blurry because the light was so dim." Nasima adds that she wants to start using Skype to communicate with her husband, who comes back home from Saudi Arabia every other year. They used to write each other letters and it took one week for them to be delivered.

It's now the end of the day and my iPhone battery is almost dead, a universal annoyance. Monirul is proud to fix as he plugs my charger into one of the house's electrical sockets.

While my phone is enjoying its first ever solar-generated replenishment, we cross the backyard

to pay a visit to Lal Mian. An administrator at the local high school, who looks forward to the benefits of electricity in his home. "Darkness will go away," he said, "and we can move around the house and the property at night." Looking at his two nephews, he adds: "their lives will improve and they will have the opportunity to study."

Yann Doignon is the Online Communications Officer in the South Asia Region unit of World Bank.

Kathryn Werntz

Kenya: Solar panels in exchange for tree planting

In an effort to reverse tree losses in the Nyeri Forest, an environmental initiative has turned to an unusual barter system, offering chickens, goats or solar panels in exchange for tree planting. "It is a win-win situation," said Joram Mathenge, director of the Kiangure Springs Environmental Initiative (KSEI), based in central Kenya's lush highlands.

Nyeri County, known for its tea and coffee production, is home to the late Nobel Peace Prize winner and environmentalist Wangari Maathai. It has the highest tree cover in Kenya but its forests are dwindling as a result of human encroachment, some of it driven by climate change pressures on agriculture and water.

That loss of forest is problematic for more than Nyeri County itself. The forested hills are a vital water catchment that supplies neighbouring regions, and as the trees disappear erosion worsens, rainfall decreases and water supplies dry up.

Increasingly irregular rainfall attributed to climate change has led to crop failure, driving farmers to cut down trees for income and to graze their animals in the forest. Trees damaged by animals are particularly vulnerable to falling in strengthening flash floods, experts say.

To replenish Nyeri County's forests and protect its water catchment, two innovative programmes have turned to bartering. The programmes offer residents a "gift" in exchange for their help in the reforestation effort.

KSEI's reforestation programme lets people choose from chickens, goats or subsidized energy

technology biogas systems, solar energy packs or efficient cookstoves. In exchange, recipients agree to plant 5,000 trees a year and look after them until they are strong saplings. "That may sound like a lot of work," Mathenge said, "but the people know that the time saved cutting firewood (efficient cookstoves generally cut firewood use by 50 percent) and the increase in income from having chickens or goats is well worth it."

Peter Thaithi, one barter participant, said the programme has helped more than just his small holding, which now includes cows, goats, a solar panel, a cookstove and rainwater harvesting equipment. "Every time a tree is planted, I know the entire community benefits," he said, smiling.

Trees for tenure

Another barter system in the area offers a different kind of trade-off: Tree planting for longer tenure on the land. When rivers in the region began to run dry two decades ago, some residents of Nyeri County took a government handout of cleared forest land parcels, which had a better water supply.

The problem is the parcels were taken and then given out - in what may have been irregular deals, Mathenge said. The Kenyan government has now devised a scheme to recapture these lands, which are key to protecting the water catchment. Farmers are allowed to stay on the land temporarily, continuing to farm as long as they plant and look after tree saplings. Once the saplings reach maturity and begin to shade the farmers crops, the

farmer must leave. "Instead of chasing them out with a whip, they instead push people off the land slowly and in a sustainable way," Mathenge jokingly explained. "In the past, people would be pushed off the land for reforestation. At night, they would rip up the saplings and destroy their roots," Mathenge said. Now that problem is disappearing, he said, as farmers gain a better understanding of the value of tree cover.

Reforestation programmes in the area also have cut forest losses by harnessing an unusual ally: HIV-positive people in the region. Nyeri County suffers from a moderately high HIV prevalence rate, which UNAIDS estimates at 3 percent.

That status can drive deforestation, Mathenge and other environmentalists said. "First, we've noticed that people who are HIV positive often resort to cutting down the trees in desperation to pay for the anti-retroviral drugs which are not always free," Mathenge explained. "And perhaps

they need money for food with higher nutrition, (which is) important to living a healthy life with HIV.

"Further, HIV infection rates are highest among people in exactly the same age bracket from which we need people to be economically productive and contributing to the work of environmental conservation," Mathenge said.

As a result, "we work with HIV-positive people and AIDS orphans," he said. "We must have a healthy community to have a healthy environment."

Kathryn Werntz is working for the Thomson Reuters Foundation.

John Magrath

Lighting up learning - getting connected in Zimbabwe

In a classroom in a remote rural area of Africa Sixth Form students are engaging in a history lesson, earnestly analysing the controversies related to the origins and rise of Great Zimbabwe, the astonishing ruins of a civilisation that stunned early European explorers and colonists.

There is nothing so unusual in that but what is remarkable is that in a school 20 kilometres from the nearest (unreliable) electricity grid, this class is studying texts, photographs and videos projected onto the wall from a computer; in fact, one of three computers in the classroom. The computers are powered by electricity from solar panels on the school roof, and two more computers and a photocopier/printer are in use in the administration block.

Gomba High School (motto 'Discipline, Drive, Determination') has been fitted with solar power for lights, computers and also for water pumping as part of an Oxfam-led scheme called RuSED - Rural Sustainable Energy Development Project - funded by the European Commission and by Oxfam.

History teacher Takuranavo Chivasa explains that although some pupils had visited Great Zimbabwe, others had not and trips were expensive. But for them "it isn't necessary because we have the videos about the controversies and you can see the walls and the patterns, and it's the same as if you were there."

For pupils, he says, having access to the internet has fired their imaginations and encouraged reading. It has even changed their attitude towards

learning because - and he smiles in amusement - they seem to believe that what is on the internet must be more reliable than what teachers or textbooks tell them "even though we say it's the same information as is in the textbooks".

For teachers Mr Chivesa says there are two great advantages, one being simply to be able to project text onto the wall and not spend time writing in chalk on the blackboard with his back to the class. The second is the ability to find and download new textbooks, many by foreign publishers, which is cheaper and easier than trying to locate textbooks locally which can be scarce, old, expensive or damaged.

Caution Gama, aged 18, is one of the Sixth Form students in the classroom and he is delighted with what computers have brought to his favourite subject, geography, and how he "can search and get access to photos and films of Mount Kilimanjaro and learn more about volcanoes".

Solar lighting and solarised computers are also in use at Mataruse Secondary School. Light enables students to study after school hours. Mataruse School Deputy Headmaster Denilly Maphosa explains: "The children really want to read! But they don't have a chance during the day, they are so busy; so it is only at night, and if they have no light they cannot". The school re-opens at 6p.m., the solar bulbs are switched on and often up to 30 students will return and read or do their homework; sometimes Mr Maphosa will teach extra lessons. So keen are the pupils to learn that evening classes can go on as late as 10 p.m.

For the future, staff at both schools are confident that they can raise the funds not only to maintain the solar systems but also to expand them, and to purchase more computers. The local authorities are involved and parents are hugely supportive and willing to pay a fee for use of the computers, and more money is raised from charging people for taking water supplied by the solar water pump.

In such ways Oxfam aims to help people create

a 'solar system' in the district that will be self-sustaining via improvements in health, education, production and ability to pay for solar products.

John Magrath is a programme researcher at Oxfam GB.

Aamir Saeed

In Pakistan, solar lamps turn women into green energy entrepreneurs

As the sun sets and darkness falls over a village outside Bahawalpur, Shama Bibi switches on her solar lantern and starts sewing clothes for an upcoming family wedding. Not long ago, nightfall would have forced her to stop working. But now with access to solar-powered lamps, Bibi can sew as long as she needs to. "The solar lantern has changed my life," said the 35-year-old widow and mother of three. "I can sew clothes even in the night and earn enough to make both ends meet."

Bibi has recently become a "Light Lady", one of the women that the Buksh Foundation, a non-profit organisation in Lahore, has trained to help spread the benefits of solar energy throughout rural Pakistan. Under the foundation's project Lighting a Million Lives, in collaboration with The Energy and Resources Institute in India, women are taught how to operate and maintain solar charging stations in their homes.

The two "Light Ladies" in each of the focus villages also are given 50 solar lanterns to rent to others in their community. The one-time cost of around \$5,500 to set up a solar charging station and set of lanterns is funded by donors. Bibi says she charges a daily rent of 4 rupees (\$0.04) per lantern and earns around 5,500 rupees (\$54) each month. "I've started sending my youngest son to school as I earn enough now to meet all the expenses," she said.

Villagers can also charge their mobile phones at

the solar station, instead of having to travel to Bahawalpur and back. The foundation has so far installed solar charging stations in 150 off-grid villages around the country and plans to reach 4,000 villages by 2017.

Light beyond the grid

According to the World Bank, about 44 percent of households in Pakistan are not connected to the grid. More than 80 percent of those are in rural areas. There, almost half of households use kerosene as a primary or secondary source of lighting, a 2012 World Bank survey found. Some use candles, due to the high cost of kerosene.

"Our target is to provide sustainable energy to far-flung rural off-grid areas of Pakistan and we especially want to empower women in these areas through the project," said Fiza Farhan, CEO of the Buksh Foundation. She said the solar lanterns not only are convenient and a source of income for some villagers but also help reduce climate-changing carbon emissions, as each lantern replaces around 500 to 600 liters of kerosene during its 10-year lifespan.

The foundation has a permanent help line at its central office in Lahore to keep in touch with the "Light Ladies" and provide them technical assistance round the clock, Farhan said. She said dozens of people contact the foundation daily asking for more solar lanterns in their villages and requesting the installation of charging stations in nearby vil-

lages. "More women want to become Light Ladies, but for the moment we have been training only two women in each village," she said, to ensure that each woman makes a decent income once the profits are split.

More solar, fewer blackouts?

Qamar-uz-Zaman, a climate change advisor to the sustainable development organisation LEAD-Pakistan, said Pakistan's energy shortages could be reduced substantially if the government would provide technical and financial assistance for sustainable development initiatives such as Lighting a Million Lives.

Pakistan faces a year-round electricity shortfall that hits around 7,000 megawatts in the summer. The country's rural areas often suffer blackouts of more than 14 hours a day while urban areas can experience up to 10 hours a day without power. To tackle the crisis, the government needs to support off-grid solar projects and encourage people to use renewable energy sources to decrease the stress on the national grid, said Zaman. "The government

can subsidise the projects by claiming international climate financing and reaching out to international donors to fund them," he said.

Gul Muhammad, 62, a farmer in the village outside Bahawalpur, can attest to the benefits of solar energy. The lantern he hires from one of the "Light Ladies" has allowed him to cut the amount of kerosene he uses to light his farm, saving him 350 rupees (\$3) each month.

The availability of cheap, portable light also means he can irrigate his farmland during dusk and dawn, times of day that previously were too dangerous due to the presence of snakes in the area. "I can now work three to four hours extra on my farmland," he said. "And this is helping increase my income too."

Aamir Saeed is an Islamabad-based freelance writer for the Thomson Reuters Foundation.

Rachel Posner Ross

Myanmar's path to electrification: the role of distributed energy systems

With Myanmar's historic elections around the corner, the international community has focused its attention on this former military regime's transformation toward democracy. But in every political scenario following the November 2015 elections, Myanmar has immense needs for investments to mitigate problems with energy access, capacity, and reliability that hinder the country's prospects for economic development. Today, Myanmar has one of the lowest electrification rates in Asia. The recent census documented only 32 percent of households use electricity as the main energy source for lighting and 69 percent still use firewood as the primary energy source for cooking. The communities and businesses already connected to the national grid experience frequent power outages due to inadequate supplies and degraded infrastructure. As Myanmar's rural population seeks tangible improvements to their quality of life, electrification represents an opportunity for the government to bring near-term legitimacy to the political and economic reform agenda.

A recent influx of donors – including bilateral and multilateral partners, private companies, and charitable foundations – are making significant investments to improve electricity access in Myanmar. In September 2015, the World Bank approved a \$400 million loan to support the first phase of the Myanmar government's National Electrification Plan (NEP), which aims for universal

electricity access by 2030. The World Bank estimates the total cost of connecting the national grid to 7.2 million households by 2030 (excluding generation and transmission costs) is \$5.8 billion. To attract such financing, Myanmar will need a strong regulatory framework that guides private and public energy-related investments.

However, Myanmar's investment environment is characterized by ambiguity and rapid change as the country pursues a broad reform agenda after newly reopening to Western trade and investment. In particular, the electric power regulatory framework includes new laws and policies at high levels, but detailed implementing guidelines and standards are still under development, leaving investors uncertain about legality and market feasibility of private electrification projects. Practitioners expect this ambiguity to continue at least until a new government is formed following the 2015 elections.

In the meantime, the development community is largely promoting distributed renewable energy solutions – meaning localized options such as mini-grids and solar home systems – to provide lighting and electricity to rural communities. While extension of the national electric grid will play an essential role in advancing toward the country's 2030 target, in the medium term many rural customers will remain far from the grid and unable to afford connection fees.

Advocates and practitioners point to the coun-

try's abundant renewable energy resources and history of village-level, self-organized use of distributed energy systems as momentum for further off-grid investments. For example, local developers in Shan State have installed hundreds of micro-hydropower sites to electrify thousands of households. In rice-growing areas across the country where feedstocks are abundant, it is estimated that local entrepreneurs have installed more than 1,000 rice-husk gasifiers to power rice mills and provide electricity to local communities. And as solar products have become widely available on the open market, thousands of households have purchased their own solar home systems on a self-help basis.

Myanmar's government has also committed sizable resources for off-grid renewables. Between 2013 and 2015 fiscal years, the Department of Rural Development distributed at full subsidy over 200,000 solar home systems and more than 100 mini-grids, with a ten-fold program budget increase reaching \$37 million for 2015. But with vast electricity needs (for 70 percent of the population), Myanmar will need a robust private market and commercially viable technologies – accessible and affordable for the rural poor – to enable distribution at the levels needed to meet rural energy needs.

Commercial viability for distributed renewable energy systems remains a challenge in Myanmar. Project developers face regulatory ambiguity, market-distorting subsidies, and a rapidly extending electric grid that influences where their systems are appropriate for installation and sale. But the government's village-level plans for grid extension are not yet publicly available. Without the right information (nor clear legal and technical guidelines for grid interconnections), mini-grid service

providers risk making plans that become obsolete if their target communities will be connected to the grid soon.

In addition, Myanmar's financial environment presents a barrier to commercial development of off-grid renewables. The country's banks are acknowledged as offering inadequate financial services, as most borrowers are limited to one-year loans at 13 percent interest rates with high collateral requirements. But the situation is slowly improving with financial reforms. More business financing is anticipated now that several foreign banks received final licenses, opened branches, and launched the first foreign bank operations in Myanmar in decades. For consumers, some micro-finance institutions are offering small loans for purchasing solar lighting kits and the telecommunications firm Telenor is poised to partner with Yoma Bank for a mobile money service (pending further guidelines from the Central Bank of Myanmar).

Looking ahead, Myanmar's policymakers will need to create an enabling environment for businesses; detailed regulations and standards are needed to clarify the role of small independent power producers in Myanmar's electrification. As policies and plans are finalized, sharing information and data among public and private players will allow stakeholders to coordinate and target activities appropriately, thus maximizing resources available to meet Myanmar's electrification and development goals.

Rachel Posner Ross is an adjunct fellow with the Energy and National Security Program at CSIS.

Devanik Saha

Decoding Modi's 'power' play: 'Electrification' doesn't necessarily mean electricity in homes (India)

During Prime Minister Narendra Modi's speech at the Wembley stadium in London on November 13, 2015, he said: "As many as 18,000 villages need electricity. There are not even electricity poles. In the next 1,000 days we will ensure they get it."

FactChecker found that his statement of 18,000 villages in India not having electricity was almost correct. But the larger issue is that—in the Indian experience—getting a power line to a village is one thing; ensuring all homes have electricity is quite another.

As many as 580,934 of 597,464 villages (97.2%) India were "electrified" as on September 30, 2015, which effectively means that 16,530 do not have electricity, according to a recent report by Central Electricity Authority (CEA).

However, the Deen Dayal Upadhyay Gram Jyoti Yojana (DDUGJY), launched by the BJP government, puts the number at 16,589.

The discrepancy can probably be attributed to an error in calculation.

The 15 States and Union Territories that have achieved 100% village electrification this year are: Andhra Pradesh, Goa, Gujarat, Haryana, Kerala, Punjab, Sikkim, Tamil Nadu, Telangana, Chandigarh, D & N Haveli, Daman & Diu, Delhi, Lakshadweep and Pondicherry.

Earlier this week, the Union Minister for Power, Coal and New & Renewable Energy, Piyush Goyal, launched the Grameen Vidyutikaran (Rural Electri-

fication) application to enable citizens to track the electrification of villages on a real time basis.

It even displays the contact details of field engineers managing the electrification of each village. However, the number of un-electrified villages shown in the app is as of April 2015.

But does a village being declared "electrified" mean that households get electricity?

"The key issue that remains ambiguous is what defines "power for all" — Is it just electrification of villages or to provide quality and adequate electricity to all households?," writes Debjit Palit, Associate Director, The Energy and Resources Institute (TERI) in his column for The Hindu. "While the NDA government is talking of 24x7 power to households, no blueprint has yet been prepared."

The definition of electrified village has changed over the years. Before October 1997, a village was classified as "electrified" if electricity was used within its revenue area for any purpose whatsoever. After October 1997, a village was declared "electrified" if the electricity was used in the inhabited locality, within the revenue boundary of the village for any purpose whatsoever.

The Ministry of Power defines a village (from 2004-05) as electrified if:

Basic power infrastructure, such as a transformer and distribution lines, is provided in the inhabited locality, as well as associated Dalit bastis (Dalit settlements, which are often excluded from village facilities), where they exist.

Electricity is provided to public places, such as schools, panchayat (village council) offices, health centres, dispensaries, community centres etc.

The number of households electrified should be at least 10% of the total number of households in the village.

Habitations with population below 100 are still excluded from DDUGJY, as the FAQs section of its website explains:

Question: "The main village has been electrified but our habitation is left out, when will it be electrified? Whom should I approach?"

Response: Habitations with population below one hundred are not included as per the approved DDUGJY programme. It is proposed to cover the left out habitations, if any, in the phase-II of the programme. The commencement of phase-II is to be decided by the Govt. of India.

"The first threshold for electrification should be at least 50% of homes in a coverage area (i.e., the majority)," wrote Rahul Tongia, a Fellow at Brookings Institution and Advisor to the Smart Grid Task Force, Government of India. In this column in The Hindu, he argued that actual electricity is im-

portant—and that there should be no power cuts—to achieve meaningful electrification.

96% of north Indian villages 'electrified', but only 69% homes have electricity

Almost 96% villages in north India are electrified but only 69% of homes have electricity, as IndiaSpend had found earlier, based on a report by Access to Clean Cooking Energy and Electricity – Survey of States (ACCESS) that draws data from six states.

Even if a household has an electricity connection, power supply is erratic across states.

In Uttar Pradesh, for instance, three of four households get electricity for less than 12 hours a day. In Jharkhand, only 2% of electrified households get electricity for 20 or more hours; 81% do not get four or more hours in the evenings, while 60% face three or more days of total blackouts every month.

Devanik Saha is freelance journalist in Mumbai.

GVEP International

Business mentoring bringing solar to more off-grid customers in Rwanda

GVEP is supporting entrepreneurs in Rwanda to effectively utilise solar energy to provide off-grid areas with healthy, reliable and affordable power through a mentorship programme. 27-year-old Mbacyenge Jean Bosco dropped out of high school in 2003 to let his younger sister acquire an education, as his parents could not afford the school fees for the two of them. Life became difficult for him, as he engaged in casual jobs to make ends meet.

A year later, determined to set up a business of his own, he purchased a car battery and started a phone charging and hair cutting activity at the Gasharu business centre in Gisagara district, in Southern Rwanda. However, travelling for 5 km every few days to recharge the battery in the nearest town centre was a major operational cost that his business could hardly sustain.

Burning with ambition, the enterprising Jean Bosco acquired a 60 Watts solar panel in 2006 for \$160 (120,000 RWF), which he used to power his hair cutting and phone charging salon in the sleepy village of Nyabisagara.

Noticing that most of the area's residents depended on kerosene lamps and candles for lighting, Jean Bosco saw an opportunity to start supplying solar power to the neighbouring households. "I was well aware of health and safety hazards of using kerosene lamps and candles on a daily basis. Additionally, because I dropped out of school, I'm keen to see that children are able to

study with proper illumination and to perform better in their studies", he says.

For Jean Bosco, however, technical knowledge was a challenge. He was unsure about the capability of his solar system. Its improper installation and the lack of a regulator saw him lose a considerable amount of power. Financial management, marketing and customer care were also major challenges for the new entrepreneur.

GVEP spotted his potential and enthusiasm and enrolled him in the Capital Access for Renewable Energy Enterprises (CARE2) programme in 2014 to help him meet the community's growing energy demand. GVEP's team assisted Jean Bosco in expanding the size of his system. From the business' savings, he bought two 100 Watts solar panels, enough to power both his business and 8 households.

On average, Jean Bosco makes between \$100-107 (75,000 and 80,000 RWF) from the phone charging and hair cutting businesses. "On a daily basis I charge between 25 and 30 phones and shave between 15 and 20 people. In addition I supplement my income by supplying any excess power to the neighbourhood", he says.

Some of the neighbouring households have also set up shops and businesses that are solar-powered. The rural centre is now abuzz with activity with some businesses remaining open late into the night.

GVEP has also supported Jean Bosco in con-

ducting market development activities, through which he has been able to expand his clientele in the area. "We have been steadfast in supporting innovative entrepreneurs in the energy sector in Rwanda in order to enable those in off-grid areas to access energy. We recognise that services such as phone charging among the rural population are essential, as most locals walk long distances in order to charge their phones", says GVEP Rwanda Country Manager Herbert Nyaga.

The expansion of his solar business has transformed Jean Bosco's life, as he has been able to purchase a piece of land where he grows bananas for commercial purposes. He has also bought the business premises that he previously rented. He now plans to purchase a maize and cassava milling machine that will serve local residents.

"We are glad that the availability of renewable energy technologies in off-grid areas has already motivated many entrepreneurs to develop solar charging or other solar-powered businesses, as a way of generating additional income. We offer mentorship to these entrepreneurs to ensure they provide the best services, while at the same time reaping optimum benefits from their energy enterprises", says Herbert.

GVEP International is a non-profit organisation working with businesses in developing countries to increase access to modern energy and to improve the quality of lives for millions of people.

Samson Tsegaye

A project lights up Ethiopian solar village Arso Amba

Arso Amba is a village located 230 km far from Addis Ababa in North Shoa Zone, Amhara Regional State. It has an estimated population of 5000 people. However, the community, by virtue of its location, has limited access to basic infrastructure, such as roads, water and electricity.

The Solar Energy Foundation (SEF) is an International NGO established in Germany in 2005 and registered in Ethiopia in 2007. The objective of the foundation is to create access to renewable energy for rural households in Ethiopia. Since its registration, it signed different project agreements with regional and federal bureaus. So far, it disseminated over 30,000 different sized solar lighting systems and trained and employed 64 staff in the foundation's training centre. The foundation has also provided several trainings to officials from different energy bureaus' staff, microfinance institution groups, and others.

In 2014, the foundation signed a project agreement with Amhara Regional State to electrify one village per year, and Arso Amba was the first village selected for this project. The beneficiary had to contribute 25% of the material cost, while the foundation covered 75%. The project began to operate in September 2014 and ended in May 2015. For targeted 800 households, 712 solar lighting systems were installed on credit instalment and cash payment bases and each system comprised 4 lamps, a mobile charging system and radio use options. Other partners engaged in this project were The Energy and Resources Institute (TERI)

through the DFID- TERI Clean Energy Project, in partnership with HoA-REC&N in Ethiopia.

Arso Amba's dwellers are now using the solar lights in their homes in various ways. Before they purchased the solar lights, their main sources of lighting were kerosene lamps and burning firewood. The laborious task of sourcing firewood is assigned to women and girls in the community. In the case of kerosene, the current high costs, coupled with the low light intensity; smoke fumes and smell made it less attractive for communities. Most residents of the village own mobile phones, but have no power supply to charge their phones. As a result, they had to send their phones to the nearest electrified village and pay a fee to charge them.

Mrs. Memo Masresha, 38, a resident of Arso Amba, has four children. She says her household is much happier today since installing the solar home system in their home. She had had many problems before because of "kuraz"- a device that burns kerosene in a bottle. "Our house was unsecured," she said, "Many houses burnt down in this village, even kids died because of fire set from the "kuraz" or burning firewood." Her health was also at risk, as she had to walk a very long distance to fetch water.

Mrs. Memo's daughters also had to collect firewood several times a week, so they could hardly go to school regularly and concentrate on their studies. But now, she and her children have cleaner and better lighting at home. "Our kids can study in the evening and also help us in our daily activities. We don't worry about the dangers posed by

fire. No additional costs from purchasing kerosene, and its bad smells do not affect us," said Mrs. Memo.

Mrs. Memo also added that these days she is able to spend more time with the family in the evenings. "When our kids got sick in the dark, it was very difficult to find our Kuraz and the matchsticks. But today we just switch on the solar light in case of emergency," she said.

Today, shop owners in Arso Amba could manage to extend their opening hours to 10 pm. However, before the installation of the solar lights, they had to close their shops immediately after sunset. But now they earn more income because they are open later.

Besides, the foundation also equipped health clinics in Arso Amba with a solar cooling system that allows pharmacists to store medicines for emergency cases. Since its inception in Ethiopia,

SEF has successfully installed 2,400 solar home systems in Rema on an initial aid bases; 5400 systems in 15 rural villages in 4 major regions namely: Amhara, Oromiya, SNNPR and Tigray. As a result, the Foundation has replaced 7,800 kerosene lamps with solar lighting systems. In doing so, it has contributed to the reduction of carbon emission. It also established a Solar Valley Campus, which hosts the first International Solar Energy School in Ethiopia, the foundation's offices, and a solar assembling plant.

Samson Tsegaye is CEO of STM Solar Technologies Manufacturing (Addis Ababa) and Country Director of Stiftung Solarenergie Ethiopia.

Appendix

Authors

Abuga, Jerry	Communications & Knowledge Management Officer, East Africa at GVEP International.
Adams, Nancy	Communications Administrator at MIT D-Lab.
Asher, Jeffrey	MIT's Comprehensive Initiative on Technology Evaluation suitability adviser and consultant.
Babbs, Morgan	Founder & CEO at Colibrí.
Blyth, Andrew	Adjunct lecturer, University of NSW Canberra at ADFA
Borofsky, Yael	Graduate student and researcher at Massachusetts Institute of Technology.
Burkart, William	Founder and CEO of Burkart Consulting.
Cho, Agnes	Program associate at Global Partnerships.
Cipriani, Simone	Head and founder of the International Trade Centre's Ethical Fashion Initiative.
Cross, Dr. Jamie	Senior lecturer in social anthropology and development at the University of Edinburgh.
de Oliveira Andrade, Rodrigo	Latin America correspondent at SciDev.Net.
Doignon, Yann	Online Communications Officer in the South Asia Region unit of World Bank.
Dovey, Dana	MA in Journalism and Media Communications and is writing for Medical Daily.
Fasimpaur, Karen	Independent consultant.
Gifford, Jonathan	Editor in Chief at pvmagazine.
Grady, Barbara	Senior writer at GreenBiz.com.
Guay, Justin	Program officer at the Packard Foundation working on energy and climate issues.
GVEP International	A non-profit organisation working with businesses in developing countries to increase access to modern energy and to improve the quality of lives for millions of people.
Higgs, Jeremy	Co-founder and director of operation of EcoEnergyFinance, a venture aiming to provide affordable solar energy to rural Pakistan.
Hower, Mike	Senior Writer GreenBiz Group.
Indrawati, Sri Mulyani	Managing Director and Chief Operating Officer at World Bank.
Jackson, Tom	Africa-based technology, energy and business reporter and co-founder of Disrupt Africa.
Johnson, Georgie	Social media editor at Greenpeace.
Kibii, Caroline	Environmentalist.
Lavelle, Marianne	Staff writer for The Daily Climate.
Leopold, Aaron	Practical Action's global energy representative.

Levi, Patricia	Graduate student and researcher at Massachusetts Institute of Technology.
Limbe, Lydia	Freelance features writer who is based in Nairobi Kenya.
Magrath, John	Programme researcher at Oxfam GB.
Manglik, Vrinda	Associate Campaign Representative for the Sierra Club's International Program.
Mehra, Varun	Graduate student in MIT's Engineering Systems Division and a Research Fellow with the MIT Tata Center for Technology and Design.
Mills, Evan Ph.D.	Senior Scientist at Lawrence Berkeley National Laboratory, University of California.
Miltenburg, Anne	Nomadic designer, brand developer and writer.
Mungai, Christine	Writer/ Journalist/ Researcher with Mail & Guardian Africa.
Murray, Sally	Country economist at the International Growth Centre (IGC). She works in Rwanda, overseeing the IGC Rwanda's research on urbanisation, energy, public sector performance and tax.
Nkosi, Phindiwe	Journalist, travel writer, and book author.
Ortegón, Lina Salazar	Employee of Opportunities for the Majority (OMJ) at the Inter-American Development Bank since January 2012.
Patton, Aunnie	Innovative finance lead at UCT GSB's Bertha Centre for Social Innovation and Entrepreneurship and an Associate Fellow at Saïd Business School, University of Oxford.
Pearlman, Jonathan	Journalist in Sydney.
Pledger, Marcia	Business reporter and columnist for the Plain Dealer.
Posner Ross, Rachel	Adjunct fellow with the Energy and National Security Program at CSIS.
Potter, Ian	INSEAD Distinguished Fellow with INSEAD's Global Private Equity Initiative (GPEI).
Rodriguez, Ed	Veteran of the power semiconductor, power supply and LED lighting technology industries.
Saeed, Aamir	Islamabad-based freelance writer for the Thomson Reuters Foundation.
Devanik Saha	Freelance journalist in Mumbai.
Schützeichel, Dr. Harald	Founder of the Solar-Federation (www.solar-federation.org) and editor of Sun-Connect News.
SciDev.Net	Source of news about science and technology for global development.
Scoones, Ian	Professorial Fellow, STEPS Centre, the Institute of Development Studies, University of Sussex.
Shah, Rahul	Asia Project Manager for the Mobile for Development Utilities Programme at GSMA.
Sinofsky, Steven	Board partner at Andreessen Horowitz, an adviser at Box Inc., and an executive in residence at Harvard Business School.
Solar Novus Today	Brings daily blogs, solar re-search and original feature articles for the world-wide solar industry.
Stassopoulos, Tassos	Growth portfolio manager at AB; Global/International Research Growth Sector Head for the consumer sector.

Stoneburgh, Jennifer	Senior Associate at MaRS Cleantech Venture Services.
Szatow, Tosh	Director of Energy for the People.
Tomlinson, Daniel	Access-to-energy entrepreneur and 2012 Echoing Green Fellow.
Tsegaye, Samson	CEO of STM Solar Technologies Manufacturing (Addis Ababa) and Country Director of Stiftung Solarenergie Ethiopia.
Upadhyay, Anand	Associate Fellow with The Energy and Resources Institute (TERI, New Delhi).
Ustun, Taha Selim	Assistant Professor of Electrical and Computer Engineering at Carnegie Mellon University.
Walton, Robert	Contributing Editor at utility Dive.
Werntz, Kathryn	Employee of the Thomson Reuters Foundation.
Winiecki, Jacob	Consultant for CGAP (Consultative Group to Assist the Poor).

Sources

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Abuga, Jerry

Solar energy entrepreneur with keen eye for opportunity

<http://www.sun-connect-news.org/business/details/solar-energy-entrepreneur-with-keen-eye-for-opportunity/>

Adams, Nancy

D-Lab off-grid energy group launches solar lighting product comparison resource

<http://news.mit.edu/2015/d-lab-grid-energy-group-launches-solar-lighting-product-comparison-resource-1211>

Asher, Jeffrey

The 'Robin Hood' model: A sustainable product testing for developing countries

<https://www.devex.com/news/the-robin-hood-model-a-sustainable-product-testing-for-developing-countries-86656>

Babbs, Morgan

4 ways in which the solar distribution market differs between East Africa and Central America

<http://www.sun-connect-news.org/business/details/4-ways-in-which-the-solar-distribution-market-differs-between-east-africa-and-central-america/>

Blyth, Andrew

How crowdfunding might secure energy access

<http://www.smh.com.au/comment/how-crowdfunding-might-secure-energy-access-20150717-gjege2>

Burkart, William

Impact investing needs a better way to measure impact

<http://www.burkartconsulting.com/blogroll/2015/7/15/impact-investing-needs-a-better-way-to-measure-impact>

Cho, Agnes

How to meet the solar needs of the rural poor — 3 lessons learned

<http://www.globalpartnerships.org/featured-stories/3-lessons-solar-distributor/>

Cipriani, Simone

Africa: the incubator of tomorrow

http://www.huffingtonpost.com/simone-cipriani/africa-the-incubator-of-t_b_8655550.html

Cross, Jamie

Why solar lanterns can't compete with the grid: Life without light in rural India

<http://www.theguardian.com/global-development-professionals-network/2015/jun/04/electricity-rural-india-solar-lanterns-the-grid-energy-access>

de Oliveira Andrade, Rodrigo

Indoor air pollution may kill 4 million a year

http://www.scidev.net/global/pollution/news/indoor-air-pollution-kill-4-million-year.html?utm_medium=email&utm_source=SciDevNewsletter&utm_campaign=international%20SciDevNet%20update%3A%202022%20June%20202015

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Devanik Saha

Decoding Modi's 'power' play: 'Electrification' doesn't necessarily mean electricity in homes (India)
<http://www.firstpost.com/india/decoding-modis-power-play-electrification-doesnt-necessarily-mean-electricity-in-homes-2513230.html>

Doignon, Yann

Lighting up the future in Bangladesh
<http://blogs.worldbank.org/endpovertyinsouthasia/lighting-future-bangladesh>

Dovey, Dana

Water shortage problem solved with solar power? MIT makes salt water drinkable
<http://www.medicaldaily.com/water-shortage-problem-solved-solar-power-mit-makes-salt-water-drinkable-330684>

Fasimpaur, Karen

Living a good life beyond the grid
<http://www.dailyyonder.com/good-life-beyond-grid/2015/02/04/7687/>

Gifford, Jonathan

Solar plus storage becoming "new normal" in rural and re-mote Australia
http://www.pv-magazine.com/news/details/beitrag/solar-plus-storage-becoming-new-normal-in-rural-and-remote-australia_100017360/#ixzz3LadBE6wT

Grady, Barbara

Reaching the base of the pyramid — and cutting carbon in the process
<https://www.greenbiz.com/article/reaching-base-pyramid-and-cutting-carbon-process>

Guay, Justin

- The world's first securitization of off-grid solar assets
<http://www.greentechmedia.com/articles/read/the-worlds-first-securitization-of-off-grid-solar-assets>
- Why should climate philanthropy care about energy access?
<http://www.theenergycollective.com/guayguay/2245257/why-should-climate-philanthropy-care-about-energy-access>

GVEP International

Business mentoring bringing solar to more off-grid customers in Rwanda
<http://www.sun-connect-news.org/life/details/business-mentoring-bringing-solar-to-more-off-grid-customers-in-rwanda/>

Higgs, Jeremy

Pakistan: Light in the darkness
<http://tribune.com.pk/story/995407/light-in-the-darkness/>

Hower, Mike

Grid or no grid, efficiency is key to powering the global South
<https://www.greenbiz.com/article/grid-or-no-grid-efficiency-key-powering-global-south>

Indrawati, Sri Mulyani

What you need to know about energy and poverty
<http://blogs.worldbank.org/voices/what-you-need-know-about-energy-and-poverty>

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Jackson, Tom

Africa's new breed of solar energy entrepreneurs
<http://www.bbc.com/news/business-30805419>

Johnson, Georgie

Three solar power projects where women are taking the lead
<http://energydesk.greenpeace.org/2015/12/09/three-solar-power-projects-where-women-are-taking-the-lead/>

Kibii, Caroline

The women can champion use of renewable energy
http://www.the-star.co.ke/news/2015/08/14/the-women-can-champion-use-of-renewable-energy_c1185716

Lavelle, Marianne

Solar lights a healthy - and empowering - path in disasters
<http://www.dailyclimate.org/tdc-newsroom/2015/02/refugee-disaster-solar-energy>

Leopold, Aaron

Big money for energy in Africa must be spent on small producers
<http://www.eiuperspectives.economist.com/energy/big-money-energy-africa-must-be-spent-small-producers>

Levi, Patricia and Borofsky, Yael

Uncertainty in grid expansion and grid supply: A case study in Bihar, India
<http://theenergycollective.com/pilevi/2205931/uncertainty-grid-expansion-and-grid-supply-case-study-bihar-india>

Limbe, Lydia

Solar energy transforming lives in Kenya
<http://africatimes.com/2015/11/19/solar-energy-transforming-lives-in-kenya/>

Magrath, John

- Lighting up learning - getting connected in Zimbabwe
<http://policy-practice.oxfam.org.uk/blog/2015/07/lighting-up-learning-getting-connected-in-zimbabwe>
- Solar irrigation and refrigeration - improving incomes in Zimbabwe
<http://policy-practice.oxfam.org.uk/blog/2015/07/solar-irrigation-and-refrigeration-improving-incomes-in-zimbabwe>
- Solar is bringing a new world to women in Zimbabwe
http://solarenergy.einnews.com/article/277577384/Br_QkQGjWIHTmIDG

Manglik, Vrinda

Beyond-the-grid is not just about light, it's about resiliency
http://www.huffingtonpost.com/vrinda-manglik/beyondthegrid-is-not-just_b_6174222.html?utm_hp_ref=green

Mehra, Varun

Solar Pumps: India's potential to link electricity access and irrigation needs?
<http://theenergycollective.com/vmehra813/2197956/solar-pumps-indias-potential-link-electricity-access-and-irrigation-needs>

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Mills, Evan

Lifting the darkness on the price of light -- the effect of fuel subsidies in the off-grid lighting market
<http://luminanet.org/profiles/blogs/lifting-the-darkness-on-the-price-of-light-the-effect-of-fuel-sub#.VLk9qSuG98F>

Miltenburg, Anne

Five mistakes that social entrepreneurs make when crafting their brands
<http://archive.skoll.org/2015/08/12/five-mistakes-that-social-entrepreneurs-make-when-crafting-their-brands/>

Mungai, Christine

How the good old sun and wind will change Africa - and the world - as we know it
<http://mgafrica.com/article/2015-07-15-how-the-sun-and-wind-will-change-africa-and-the-world-as-we-know-it/>

Murray, Sally

Focus on Poverty: Why the grid isn't always the answer
<http://www.scidev.net/global/energy/analysis-blog/energy-focus-poverty-off-grid.html>

Nkosi, Phindiwe

Kenya's Maasai women jump-start Africa's solar revolution
<https://www.the-newshub.com/international/kenyas-masai-women-jump-start-africas-solar-revolution>

Ortegón, Lina M. Salazar

10 things a company needs to know about the market at the base of the pyramid
<http://blogs.iadb.org/sectorprivado/2015/06/18/company-market-base-of-the-pyramid/>

Patton, Aunnie

The rapid rise of impact investing
<http://www.bdlive.co.za/opinion/2015/08/11/the-rapid-rise-of-impact-investing>

Pearlman, Jonathan

Half of Australian homes to adopt solar power and move 'off grid' from 2018
<http://www.telegraph.co.uk/news/worldnews/australiaandthepacific/australia/11945075/Half-of-Australian-homes-to-adopt-solar-power-and-move-off-grid-from-2018.html>

Pledger, Marcia

Former political activist Thione Niang turns co-founder of Akon Lighting Africa: Reinvention
http://www.cleveland.com/business/index.ssf/2015/10/former_cleveland_political_act.html

Posner Ross, Rachel

Myanmar's path to electrification: the role of distributed energy systems
This piece was originally published on the CSIS Asia Policy Blog, CogitAsia at www.CogitAsia.com

Potter, Ian

Getting the Big Money into social impact
<http://knowledge.insead.edu/blog/insead-blog/getting-the-big-money-into-social-impact-4214>

Rodriguez, Ed

Is solar-powered LED lighting finally getting a chance to shine?
<http://www.edn.com/electronics-blogs/led-insights/4440223/Is-solar-powered-LED-lighting-finally-getting-a-chance-to-shine->

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Saeed, Aamir

- In Pakistan, solar lamps turn women into green energy entrepreneurs
<http://news.trust.org//item/20150727141951-y9cn9/?source=search>
- No phone signal in a disaster? Solar network 'in a box' to the rescue
<http://news.trust.org//item/20150921071547-irkea>
- Solar-powered ATMs to deliver clean drinking water in Pakistan
<http://news.trust.org//item/20150514094355-62gat/>

Schützeichel, Harald

- A new support for solar entrepreneurs: Sendea
<http://www.sun-connect-news.org/business/details/a-new-support-for-solar-entrepreneurs-sendea/>
- No Grid? No Problem! Full power access without the grid
<http://www.sun-connect-news.org/technology/details/no-grid-no-problem-the-second-wireless-revolution/>
- Off-Grid is booming! But which off-grid industry exactly?
<http://www.sun-connect-news.org/business/details/off-grid-is-booming-but-which-off-grid-industry-exactly/>
- The underestimated challenge of PAYG (Pay-As-You-Go)
<http://www.sun-connect-news.org/business/details/the-underestimated-challenge-of-payg/>

SciDev.Net

- Egyptian method filters seawater in minutes
http://www.scidev.net/global/water/news/egyptian-filters-seawater-environment.html?utm_medium=email&utm_source=SciDevNewsletter&utm_campaign=international%20SciDev.Net%20update%3A%2014%20September%202015
- Foreign firms don't boost African tech skills
http://www.scidev.net/global/technology/news/foreign-firms-african-tech-skills.html?utm_medium=email&utm_source=SciDevNewsletter&utm_campaign=international%20SciDev.Net%20update%3A%207%20September%202015

Scoones, Ian

Why access to energy is crucial for economic growth and poverty reduction
<https://zimbabweand.wordpress.com/2015/06/15/why-access-to-energy-is-crucial-for-economic-growth-and-poverty-reduction/>

Shah, Rahul

Decentralised energy market in rural Cambodia – a site visit to Kamworks
<http://dev.gsma.com/mobilefordevelopment/programme/utilities/decentralised-energy-market-in-rural-cambodia-a-site-visit-to-kamworks/>

Sinofsky, Steven

Africa's mobile-sun revolution
<http://recode.net/2015/04/29/africas-mobile-sun-revolution/>

Stassopoulos, Tassos

Power surge for women as emerging consumers
<https://blog.abglobal.com/post/en/2015/02/power-surge-for-women-as-emerging-consumers>

If clicking the link doesn't work, copy and paste the URL in a new browser window instead.

Solar Novus Today

Trojan Battery introduces "Farm from a Box" off-grid solution

http://www.solarnovus.com/trojan-battery-introduces-farm-from-a-box-off-grid-solution_N9287.html

Stoneburgh, Jennifer

Lessons learned in scaling a social enterprise to solve energy poverty

<https://www.marsdd.com/news-and-insights/lessons-learned-in-scaling-a-social-enterprise-to-solve-energy-poverty/>

Szatow, Tosh

Three common mistakes when assessing going off grid (solar and storage)

<http://energyforthepeople.com.au/content/three-common-mistakes-when-assessing-going-grid-solar-and-storage#sthash.njEkpV8E.dpuf>

Tomlinson, Daniel

- A Bull in a China shop: How SkyPower's plan to donate 2 Million solar home kits in Kenya will wreck the energy access market for decades
http://www.huffingtonpost.com/daniel-tomlinson/a-bull-in-a-china-shop-ho_b_7971326.html?utm_hp_ref=green&ir=Green
- Can conservative institutions become the most innovative forces beyond the grid?
<http://www.greentechmedia.com/articles/read/can-conservative-institutions-become-the-most-innovative-beyond-the-grid>
- Off-Grid solar firms should focus on customer experience, not just energy access
<http://www.greentechmedia.com/articles/read/can-financing-create-apple-like-delivery-for-off-grid-solar>

Tsegaye, Samson

A project lights up Ethiopian solar village Arso Amba

<http://www.sun-connect-news.org/life/details/a-project-lights-up-ethiopian-solar-village-arsoamba/>

Upadhyay, Anand

Next big thing in Bangladesh — solar irrigation pumps

<http://cleantechica.com/2015/08/28/next-big-thing-bangladesh-solar-irrigation-pumps/>

Ustun, Taha Selim

How Rwanda's clinics have gone off-grid and onto renewable energy

<http://theconversation.com/how-rwandas-clinics-have-gone-off-grid-and-onto-renewable-energy-42503>

Walton, Robert

Honey, I shrunk the grids: The emergence of 'nanogrids'

<http://www.utilitydive.com/news/honey-i-shrunk-the-grids-the-emergence-of-nanogrids/407283/>

Werntz, Kathryn

Kenya: Solar panels in exchange for tree planting

<http://www.theafricareport.com/East-Horn-Africa/kenya-solar-panels-in-exchange-for-tree-planting.html>

Winiecki, Jacob

Financial innovation and solar power: conquering energy poverty

<http://www.cgap.org/blog/financial-innovation-and-solar-power-conquering-energy-poverty>

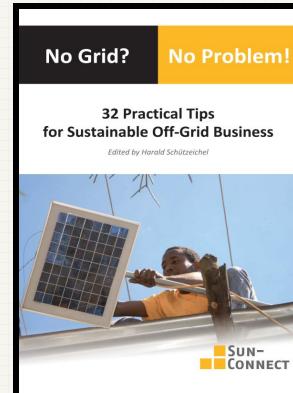
Sun-Connect News: List of publications

No Grid? Nor Problem!

32 Practical Tips for Sustainable Off-Grid Business

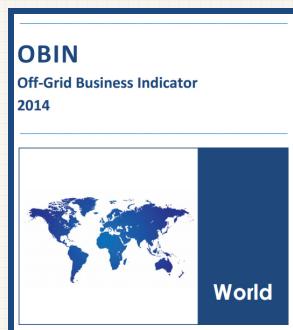
Edited by Harald Schützeichel, 2015

Free download: www.sun-connect-news.org

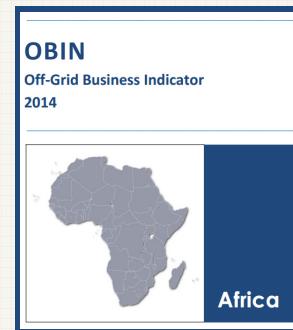


OBIN. Off-Grid Business Indicator 2014

World



Africa



South(East)Asia



America



Free download: www.sun-connect-news.org



www.sun-connect-news.org