

Accelerating Off-grid Renewable Energy

IOREC 2016
Key Findings and Recommendations

Third International Off-grid
Renewable Energy Conference

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About IRENA

The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future and serves as an important platform for international co-operation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. www.irena.org

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IOREC 2016:
KEY FINDINGS AND RECOMMENDATIONS

INTRODUCTION

Universal access to modern energy is a development imperative. Energy is a catalyst and enabler of development. Societies cannot develop without reliable, adequate and affordable energy services. Decades of national and international efforts have yielded impressive gains in access to modern energy. Yet the pace of expansion is falling well short of the levels needed to reach universal access by 2030 - a target recently adopted by the United Nations with its Sustainable Development Goals (SDGs). Estimates suggest that under a business-as-usual scenario around 600 million people will still not have access to electricity by 2040. This is an unacceptable scenario given the strong links between access to modern energy and human well-being.

The good news is that off-grid renewable energy technologies offer a cost-effective, environmentally sustainable, rapidly deployable and modular tool to accelerate the pace of electrification. Developing countries have a very

real opportunity to leapfrog the usual stages of expansion to build a sustainable, reliable, resilient and affordable power system. These technologies can trigger rural economic development - increasing incomes, creating jobs and setting the stage for transforming livelihoods.

The advances in off-grid renewable energy development have been impressive from all standpoints. For decades, locally available renewable energy resources have been harnessed for mechanical use and electricity generation. Large-scale development of community-based micro-hydro and biomass technologies has a long track record. The technology mix has further diversified with the rise of deployment in small-wind and solar PV-based technologies. Today, solar PV-based solutions have gained tremendous prominence as costs have declined and their inherently modular nature makes them ideal for adaptation to local conditions, ranging from lanterns to household systems to village-powering mini-grids.



Plenary session at the 3rd International Off-grid Renewable Energy Conference.

Outcomes from IOREC 2012 and 2014

The key findings and recommendations emerging from discussions at IOREC 2012 (Accra, Ghana) and IOREC 2014 (Manila, Philippines) are synthesized in IRENA publications – *International Off-grid Renewable Energy Conference 2012: Key findings and recommendations* (IRENA, 2013) and *Accelerating off-grid renewable energy deployment: Key findings and recommendations from IOREC 2014* (IRENA, 2015).

Conference material, including programme, speaker biographies and presentations, for all three editions of IOREC is available on the official website: iorec.irena.org



To accelerate the pace of off-grid renewable energy deployment, many different building blocks have to come together. There are no one-size-fits-all solutions, and over the past decades those engaged in the energy access sector have tried a number of different approaches. In a sector as dynamic as this, dedicated platforms are needed to facilitate exchange of best practices and lessons learned. To address this need, the International Renewable Energy Agency (IRENA) organises the International Off-Grid Renewable Energy Conference (IOREC), a global platform for sharing experiences and best practices on design and implementation of enabling policies, tailored financing schemes, innovative business models and technology applications for stand-alone and mini-grid systems.

The first IOREC was held in Accra, Ghana, in 2012. The second took place in Manila, Philippines, in 2014. The 2016 gathering met in Nairobi, Kenya, and convened the largest-ever audience of stakeholders from the sector.

In partnership with the Kenyan Ministry of Energy and Petroleum and the Alliance for

Rural Electrification (ARE), IRENA organised the third International Off-grid Renewable Energy Conference and Exhibition in Nairobi, Kenya, from 30 September to 1 October, 2016. The conference brought together over 600 stakeholders from across the off-grid renewable energy value chain, including representatives from rural electrification agencies, ministries in charge of renewable energy development, private sector, academia, financing institutions and international organisations.

In tandem with the conference, ARE organised an exhibition allowing the private sector to showcase products and projects and offer networking opportunities. Together with the Africa-EU Renewable Energy Cooperation Programme (RECP), ARE also organised a pre-IOREC business-to-business matchmaking event on 29 September. IOREC 2016 took place back-to-back with the SEED Africa Symposium (28-29 September), an international forum to stimulate growth of social and eco-entrepreneurship in Africa. This document brings together the key messages that emerged from the two-day discussions at IOREC 2016.¹

¹ All conference material, including programme, speaker biographies and presentations, is available on the official website: iorec.irena.org

KEY MESSAGES FROM IOREC 2016

1. Mainstreaming off-grid renewable energy in national rural electrification strategies

Cost reductions, technology advancements and business model innovation make off-grid renewables a mainstream electrification option for governments to consider. Globally, across different contexts, **stand-alone systems and mini-grids are more affordable and reliable than ever before**, providing a wide range of electricity services. Off-grid renewable energy solutions are no longer a fringe option for expanding access, and their role within a national strategy to reach universal access in a time-bound manner should be recognised.

"The question is not whether universal access will happen through off-grid solutions but rather how do we make it happen quickly enough?"

Adnan Z. Amin, Director-General,
IRENA

- Strategies that **consider both on-grid and off-grid solutions** can strengthen governments' efforts to accelerate the pace of electrification. Rural electrification strategies should account for available renewable resources, local

demand for electricity services, techno-economic viability of different technology solutions and existing capacity to determine the most suitable electrification options for different areas.

- The strategy should be flexible (as technology costs evolve and demand increases) and provide the basis for the expansion of electricity services as households and enterprises climb up the energy ladder.
- Off-grid renewable energy solutions need to be **introduced as early as possible in regional and national electrification planning processes**. Doing so would provide guidance to the public and private sector, as well as development banks and donors, to collaborate, mobilise and direct resources to off-grid and grid-based electrification options.

"Kenya is committed to ensuring universal access to energy by 2020. This will be achieved through exploitation of locally available energy sources including off-grid solutions"

Hon. Charles Keter, Cabinet Secretary,
Ministry of Energy and Petroleum, Kenya



Source: Shutterstock

2. Creating an ecosystem to accelerate deployment

Off-grid renewable energy solutions will play a central role in countries' strategies to achieve universal electricity access in a timely and sustainable manner. The development opportunity is immense, but it requires targeted efforts to create an environment that enables scale-up.

- The foundations for accelerating off-grid renewable energy deployment comprise dedicated policies and regulations, enabling institutional frameworks, customised business and financing models and adapted technology solutions. These should provide the basis for service providers to access the market, deploy off-grid technologies and contribute to market development. Complementary efforts are also needed to **build adequate capacity across the value chain** (e.g., financing institutions, communities) and **identify cross sector-linkages** (e.g., productive end-uses) to further enhance the sustainability of interventions. As illustrated in Figure 1, when each of these elements comes together, deployment can be

"No single actor is going to make [achieving universal energy access] happen. Partnerships will be key to accelerate the pace of energy access."

Andrew M. Herscowitz, Coordinator,
Power Africa

accelerated in a manner that maximises socio-economic benefits.

- A **sound data and market information base** needs to be developed for the off-grid sector to enable informed decisions on policies, site assessments, investment opportunities and design of delivery mechanisms. Data and information also has to be made available and accessible to market actors through platforms such as the African Development Bank's Green Mini Grid Help Desk.² The Help Desk was launched at IOREC 2016 and has been set up so developers can find practical information quickly, including market reports, business templates and financial models.

Figure 1 Key elements of an ecosystem for sustainable off-grid renewable energy deployment



² The GMG Help Desk (<http://greenminigrad.se4all-africa.org/>) is part of the larger Green Mini Grid Market Development Program implemented by the SE4All Africa Hub and funded through the AfDB's Sustainable Energy Fund for Africa (AfDB, 2016).

“Rural electrification agencies could also help with information gathering and scouting of projects which would help reduce transaction costs.”

Marcus Wiemann, Executive Director,
Alliance for Rural Electrification



Joint UNIDO-REN21 side event – “Market intelligence: How it can drive the uptake of renewables and energy efficiency in the East African Community (EAC)?”

The side event held discussions on market intelligence and its importance in defining policy and regulatory frameworks and attracting investment. The role of market intelligence as a crucial tool to assist better decision making by businesses, investors and policy makers was highlighted during the event. This side event also discussed innovative partnerships between UNIDO-supported regional renewable energy and energy efficiency centres and REN21, which has led to the timely tracking of renewable energy and energy efficiency developments. The side-event included the launch of the *EAC Renewable Energy and Energy Efficiency Status Report*.

3. Designing dedicated policies and regulations for the off-grid sector

National rural electrification strategies need to be backed by dedicated and stable policy and regulatory frameworks. Traditional, centralised electricity sector frameworks have to be adapted to support the deployment of off-grid solutions (stand-alone and mini-grids). Policies, including incentive structures, need to be designed for long-term, sustainable market development.

- The participation of the private sector will be key to complement electrification efforts by governments and development agencies, and to substantially scale-up deployment. To enable this, **a robust policy and regulatory environment is needed** to reduce investment risks, improve viability and increase the overall attractiveness of the sector.
- **Stability in policy** was highlighted to be particularly important. The example of changes in taxation policies was given wherein unscheduled changes can dramatically alter the economics resulting in a slow-down in uptake. Additionally, adequate standards and quality control measures were highlighted to be important to avoid proliferation of low-quality systems and market spoilage.
- **For renewable energy-based mini-grids**, the following key points were highlighted:
 - The viability and sustainability of mini-grids largely depend on **well-designed tariff regulations**. One approach to setting the tariffs for private sector mini-grids is to impose a national uniform tariff (which is often too low for sustainable operation) and provide sufficient viability gap funding.

Mini-grid regulatory framework in Tanzania

Tanzania has taken measures for greater private sector involvement in the mini-grid sector, such as:

- Standardised Power Purchase Agreements to cut down negotiation time between regulators and developers.
- Annual tariff adjustments to address macro-economic changes in the country (e.g., exchange rate, inflation).
- Segmented licensing, such that projects below 1 MW do not require a license, only registration of site. Projects under 100 kW are exempted from tariff regulation (EWURA, 2016).
- Technology-specific tariffs offered under the 2nd generation of Small Power Producer programme.

Over a span of 6 years, 15 PPAs have been signed with 8 under operation. Twenty-seven letters of intention have been signed.

Another approach is to allow mini-grid tariffs high enough to cover costs but still well beneath current customer spending on conventional energy in off-grid areas, as also recommended by the Southern Africa Regulators Association (SADC RERA, 2013).

- The private sector prefers **minimal touch points** with governments to improve efficiency and reduce transaction costs. By bringing greater regulatory certainty, clearly defining institutional roles and responsibilities, investment risks for mini-grids can be reduced.
- The untimely arrival of the national grid may introduce major uncertainty for the long-term viability of mini-grids. If defined ahead of time, interconnection and/or compensation mechanisms **allay risks associated with main grid arrival**. Even where interconnection provisions exist,

tariffs for the interconnected mini-grids need to be set at levels that allow for sustainable operations.

- The policy and regulatory landscape for off-grids is highly dynamic as governments introduce dedicated measures, gain experience and incorporate lessons towards the creation of a more effective framework for market development. This is essential to adapt to local conditions and address specific

"Developers in the off-grid sector still consider policies and regulations as the number-one challenge."

Daniel Schroth, SE4ALL Africa Hub Coordinator,
African Development Bank

deployment barriers. In Mozambique, for instance, FUNAE, the public fund responsible for off-grid sector development, is launching a programme to pilot new models for stand-alone solutions (e.g., pay-as-you-go [PAYG] and battery charging) and mini-grids (e.g., a public-private partnership [PPP] approach) that engage the private sector and are scalable in the short term (FUNAE, 2016).

"We [the public sector] want to give higher tariff incentives, relaxed reporting and regulatory requirements to encourage greater private sector participation."

Felix Ngamlagosi, Director General
EWURA, Tanzania



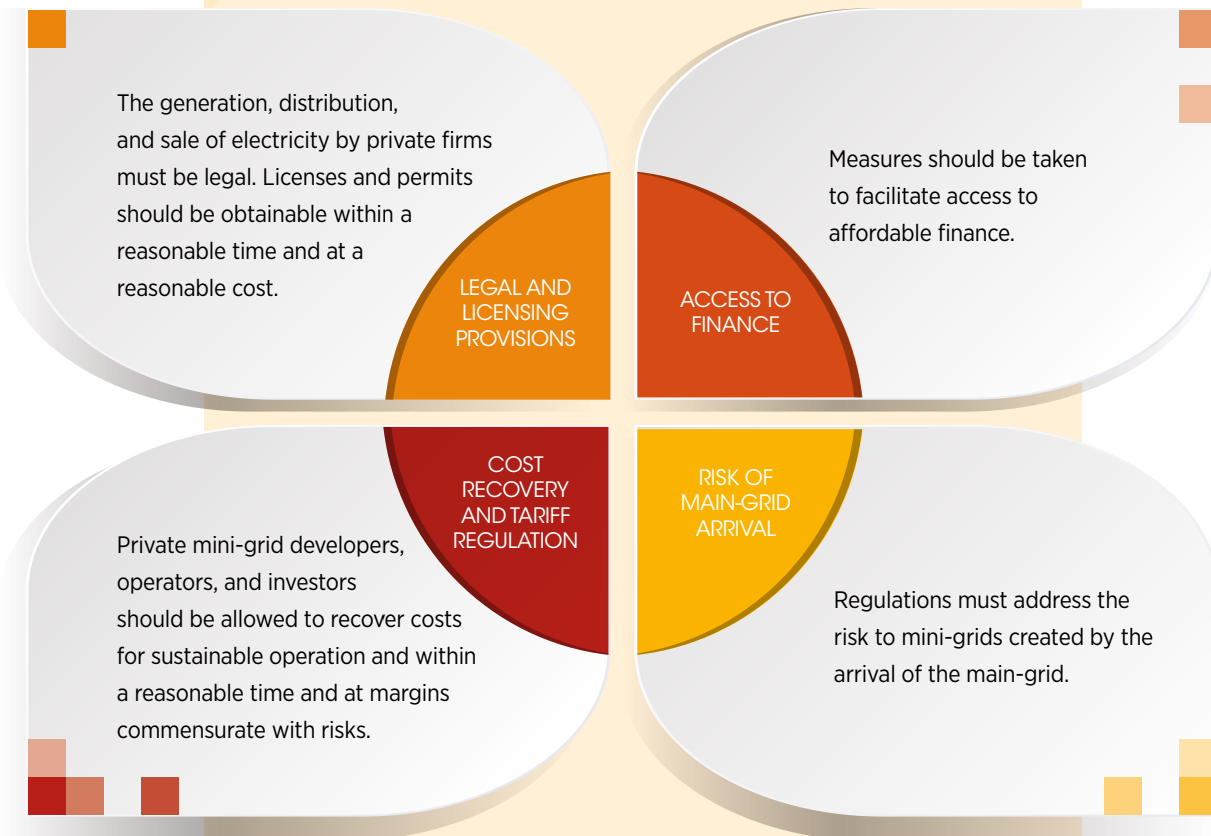
Water mill and small water fall in Phukinrongka, Phitsanulok, Thailand
Source: Shutterstock

Draft mini-grid policy in India

In June 2016, India released its draft national policy on renewable energy-based mini-grids. The objectives include mainstreaming mini-grid solutions to improve access, streamlining project development procedures, providing frameworks for operating with local distribution companies, optimising access to finance and fostering innovation in mini-grid business models.

Source: MNRE, 2016.

At IOREC 2016, IRENA launched its report *Policies and Regulations for Private Sector Renewable Energy Mini-grids* (IRENA 2016a) which provides policymakers with the information they need to design and implement tailored policies and regulations to support off-grid development. Using recent case studies as reference points, the report analyses general and technology-specific policy and regulatory measures and addresses licensing, tariff regulation, main-grid arrival risk and access to finance for mini-grids.



Source: IRENA, 2016a

4. Unlocking capital for energy access

Scaling-up off-grid renewables will require improved access to financing for enterprises and the consumers. Although investments have grown in recent years, they are far from sufficient to reach universal access goals. A number of factors are responsible, including mismatch between the typical project volume and the financing instrument, the lack of information about available financing sources, the relatively inexperienced private sector and financing institutions and related capacity constraints and lack of financial infrastructure to facilitate transactions (see Figure 2 for key challenges to mini-grid financing). Some key aspects highlighted at IOREC 2016 to catalyse investments include:

- There is **need for consistent focus, drive and public policy commitment**, as well

as readiness **to blend different sources of finance** and adapt them to the off-grid sector. Specific financing gaps remain for project/enterprise development, especially during early stages when high-risk capital is needed to build markets, try new approaches, enter new geographic areas and catalyse additional investment.

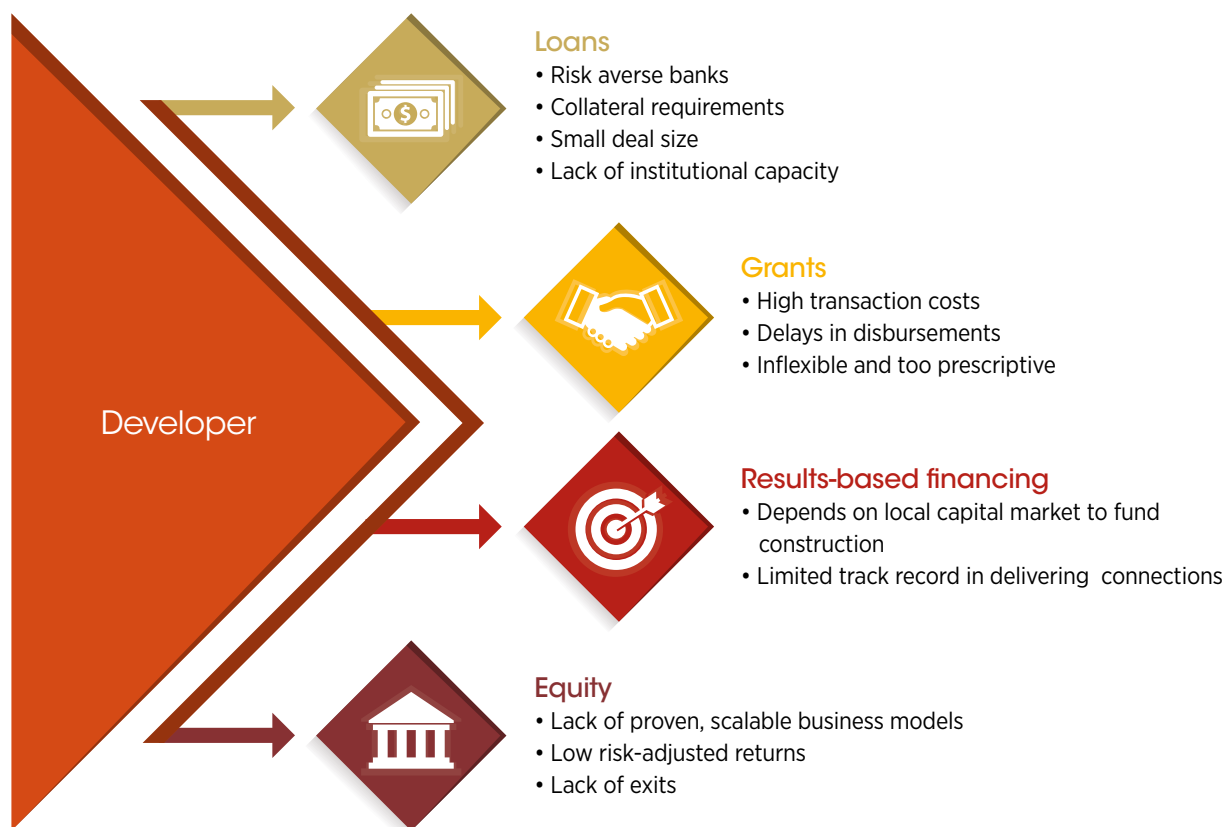
- **Disbursement cycles for public funding are often too long** and should be processed more quickly. New sources of financing also need to be explored to complement public funding. These may include foundations which can deploy capital rapidly, as well as crowd funding for raising small amounts. Knowing who to go to for funding and strong project documentation are crucial and platforms, such as the IRENA Sustainable Energy Marketplace and Project Navigator,³ can be used.

Trends in renewable energy mini-grid investments in Africa

New types of investors are entering the renewable energy mini-grid sector, including international utilities, manufacturers and IPPs. These investors (e.g., Caterpillar, E.On, Engie, Enel Green Power) are coming through project-level investments, corporate investments or as developers of own projects. In addition, bundling similar mini-grid projects in terms of technology, location and business model can address the mismatch between the demand and supply of financial capital. Regarding end-user financing, connection fees are often funded by developers themselves or could also be undertaken in partnership with local financing institutions.

³ The Sustainable Energy Marketplace (<http://marketplace.irena.org/>) offers a virtual marketplace that brings together together investors, project developers and service providers on a on a common platform to facilitate exchange of information including on available financial instrumen Project Navigator (<https://navigator.irena.org/index.html>) provides project developers with knowledge, tools, case studies and best practices.

Figure 2 Challenges facing mini-grid financing



Source: Adapted from Energy4Impact at IOREC

Need for tailored end-user financing models

Electrification programmes and initiatives are tackling the challenge associated with relatively high upfront cost of stand-alone systems through end-user financing schemes tailored to their income profiles and demand. In Bangladesh, this has translated into extending microfinance services to households to procure solar home systems. Upfront payments are typically 15 percent of the system cost followed, generally, by 36-month instalment loans, similar to monthly expenditures on kerosene, thus allowing households to afford solar home systems. In other countries, for example in East Africa, the pay-as-you-go (or PAYG) model is increasingly common wherein households follow a payment scheme for different products and services. Such an arrangement could take the form of a perpetual lease or of an eventual system ownership after a defined period of time. The ability to spread costs across smaller payments allows consumers to access off-grid technology solutions.

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- **Creating a local pool of capital** through country-led initiative and making local finance available for energy access programmes could be a way to facilitate sector development and scale-up. Unlocking low-cost, local financing will also help address the risk of foreign currency. **Guarantee schemes** are important instruments for backing up financing and addressing key investment risks, including political, currency and off-take risk.
 - Financial support programmes need to be designed with long-term market development, **sustainability and scalability** in mind. Subsidies should be integrated within a wider financial support system rather than a pure subsidy system, which might jeopardise natural scalability.
 - **Bundling of mini-grid projects** can be an effective way to reduce financing costs and project-specific risks. Bundling could help access a wider pool of financing that is otherwise inaccessible for low value transactions.
 - Practical ways should be developed to link rural consumers to **asset-based financing**. These could be tied with a specific target for banks (with low interest rates and long-term financing) and creating a risk-guarantee facility for financing institutions.
 - Drawing from the experience of countries like Bangladesh, **microfinance** can be effective in unlocking capital available from the consumer side/informal sector. Microcredit solutions entail not only understanding the consumer's credit history but also consumer behavior.

5. Identifying the right business models for deploying off-grid renewables

A strong business case can be made for off-grid renewable energy solutions, whether for unelectrified rural households, industries, or existing fossil fuel-based installations. A sustainable operational model should be in place so that customers continue to receive reliable services. Different models are being tried and tested for both stand-alone and mini-grids and key lessons include:

- In identifying the right business model, a **consumer-driven, bottom-up approach is preferred** for rapid deployment of off-grid renewable energy solutions – as it allows greater interaction and learning opportunity for both private sector and the community. This gives the private sector the flexibility and the ability to adapt its technical and business model as required.
- Energy surveys and observations at the local level are key for a proper demand assessment for system design.
- **Off-take risk and revenue generation remains key risks for off-grid** renewable energy operators. In the case of stand-alone

"Our job is to de-risk the business and if we do it right, the businesses are able to attract commercial capital and that is a signal for us to exit"

Duncan Onyango, Director of East Africa,
Acumen Fund

systems, these risks have been addressed in part through innovation in business model and metering technology (e.g., PAYG systems). In some cases, the energy service itself mitigates the off-take risk as it creates an environment for increased productive activities. For mini-grids, one way to mitigate the off-take risk is to enter into a PPA with anchor clients (e.g., telecommunication towers, rural health centres, water supply), diversify revenue generation and go into shared-value partnership where excess energy from commercial sites could be supplied to surrounding communities.

- **Public-private partnerships** can play a crucial role in enabling the participation of the private sector. A model for a scalable approach could

Launch of World Business Council for Sustainable Development's report, Business Case for Low-Carbon Microgrids

At IOREC 2016, WBCSD launched its report entitled *Business Case for Low-Carbon Microgrids*, which demonstrates the economic and technical viability of low-carbon microgrids using real project examples. The report finds that microgrids are key in providing low-carbon alternatives for people and industries without access to electricity because they enable high penetration of renewables in the energy mix while providing grid-connected customers with improved service quality and system resilience with lower emissions. The private sector is ready to scale up microgrids to reach more customers and is able to provide standardised solutions that are also modular and affordable.



PPPs to deploy off-grid renewables in Peru

A Public-Private Partnership (PPP) bidding for 200,000 solar home systems was discussed. In this model, the operator invests and operates, while a separate distribution company is responsible for billing. The government also guarantees the annual income for the investor. Twenty percent of the final tariff is paid by the consumer, with the remainder coming from cross-subsidisation. The government is planning to provide mini-grid solution to 3500 households via 2MW solar under similar concessionary agreement.

be partnerships with Rural Electrification Agency (REA)-like bodies wherein the REA provides infrastructure and the private sector is responsible for power-generating plant.

- **High-risk innovation capital** is required to drive deployment, allow learning-by-doing and encourage bottom-up sector development. It is important to foster innovation partnerships, including incubators, to stimulate local innovation and to strengthen capacity to access financing.

6. Innovating to improve accessibility, reliability and range of electricity services

For the next phase of rapid and sustainable deployment of off-grid renewable energy, technical, business and market innovation will continue to be vital. Such innovations have been instrumental in bringing down costs, improving reliability, opening new markets and providing a wider range of electricity services. Innovations across the value chain and sectors where renewable energy resides, such as health, education and agriculture, will be key to rapid deployment, and these will need to be delivered by both the private sector and the development agencies engaged in the sectors.

- **Innovation on the supply side, demand side and control side** is taking place in the off-grid space. The real game-changer for mini-grids, in particular, will come not from generation technologies but from innovation in the enabling technologies – converters, control systems and, most important, innovation on the demand side. System innovation, such as plug-and-play features and battery storage, will also be instrumental.

"Using available industrial solutions in rural electrification will bring other benefits such as the ability to be bankable, to capture larger projects and to drive manufacturing."

Pablo Astorga, Global Manager of Microgrids, ABB

- There is a need to **focus on a new generation of standardised electrical appliances** compatible with off-grid needs, especially those related to productive uses (e.g., agriculture) and basic services (e.g., health and education). Expanding the range of efficient appliances that can be powered by off-grid renewables – including sewing machines, milling machines, projectors, pipe cutters, welding machines and electric razors – will encourage adoption and catalyse income-generating activities in rural areas.

The latest edition of IRENA's *Renewable Energy Innovation Outlook* series was launched at IOREC 2016. The report *Innovation Outlook: Renewable mini-grids* (IRENA, 2016b) provides a detailed overview of the latest in mini-grid technology and the ongoing innovations transforming the sector. Ground-breaking improvements are underway for renewable mini-grids, not only in components, but also in system integration, controllability and flexibility. The report finds that technology innovation, accompanied by innovation in business models and finance, will result in a 60 percent decrease in the cost of producing electricity from renewable mini-grids over the next 20 years.



7. Strengthening the sustainability of energy access efforts and maximising benefits

While the technology to expand electricity access exists today, the delivery models need to be designed to ensure that systems operate reliably throughout their lifetime and adequate capacities are in place to undertake operation, maintenance and management. This involves focusing on the following key aspects:

"We are not interested in the supply-side paradigm. Our customers are interested in the services they receive – hours of lighting or cooling or entertainment. That is the metric we track and sell."

Jesse Moore, CEO and Co-Founder, M- KOPA

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- **Linking energy-service delivery with livelihoods** is fundamental for the viability and sustainability of energy access efforts. A paradigm change is needed in the way off-grid solutions are deployed, with the focus shifting away from capacity or generation metrics (supply-side paradigm) towards livelihoods and services (demand-side paradigm). Such a shift would mean that suppliers customise energy solutions to provide opportunities for improving livelihoods, increasing productivity and generating income, thereby contributing to multiple SDGs.
 - **Fostering local enterprises** and supporting their growth and development are effective ways to tailor local supply and demand and

"Vocational training is very crucial for the development of the sector – if you bring innovation without knowing what you are selling – it will not sustain."

H.R.H. Princess Abze Djigma, CEO, Abzesolar

make the overall sector sustainable. Strong partnerships between international actors (e.g., private sector, INGOs, development agencies) and local entities can help develop know-how and technology and collectively contribute to driving the sector forward. Local entrepreneurship can be supported through incubators and high-risk innovation funds.

Joint IRENA-IEC side event: Reliable clean energy solutions for energy access - the role of standards and quality assurance

The side event jointly organised by IRENA and the International Electro-technical Commission (IEC) discussed the importance of quality renewable energy systems in meeting the objective of universal energy access sustainably. The event stressed on the high expectations of communities and governments in terms of safety, performance and durability of the energy service provided as well as on standards and quality assurance as measures to meet them. IRENA's guidelines on developing quality-control measures as well as an interactive web-based tool⁴ to access information on international standards was showcased. IEC, the main international standardisation body for the power sector, showcased its comprehensive set of technical standards aimed for rural electrification applications.

⁴ The International Standards and Patents in Renewable Energy platform, also known as INSPIRE, is the world's largest online collection of global renewable energy standards and patents first and most complete solution of its kind. It can be accessed here: <http://www.irena.org/inspire>

- **Capacity building and vocational training** is key to increase sustainability of projects and programmes, and generate greater socio-economic impact. These need to be integrated into off-grid renewable-energy initiatives and designed for different stakeholders in the sector, including end-users, enterprises, financing institutions and policy makers.
- The **quality of the renewable energy system** deployed needs to be assured, and expectations from communities and governments in terms of safety, performance and durability of the energy service provided must be met. The use of standards in quality-assurance measures, including testing and certification, effectively addresses this issue.

8. Harnessing the cross-sector development impact of off-grid renewables

The off-grid electrification sector touches various aspects like health, climate change, education and job creation. As a result, deploying off-grid renewables helps to achieve SDG 7 (on energy) while also contributing to several other SDGs, including those related to poverty alleviation, health, water, nutrition and climate.

- Policymakers across sectors should integrate off-grid renewables as a pillar for development, thereby facilitating achievement of the SDGs. The decentralised and modular nature of renewables allows them to cater to local energy demands in areas not served by the main electrical grid, supporting rural communities as they move up the energy ladder. Off-grid renewables can also be tailored to different applications in sectors such as health and agriculture.

➤ **Off-grid renewables for health centres:**

Access to electricity plays a critical role in the functionality of health-care facilities and the quality, accessibility and safety of health services delivered to rural communities (see Figure 3). Electricity is necessary to operate critically needed medical devices such as emergency surgical and diagnostic equipment as well as to refrigerate vaccines, blood and medicines. Electricity is also needed for the operation of basic amenities, such as lighting, refrigeration, ventilation and communications. Without energy, many life-saving interventions simply cannot be undertaken (WHO and World Bank, 2014).

- An estimated 1 billion people globally are served by health facilities without electricity (Practical Action, 2013). Furthermore, facilities with access often have an unreliable supply. Diesel generators, where used, struggle with both high fuel costs and unreliable fuel delivery. This lack of access to reliable energy contributes to the health-care challenges developing countries face, including high maternal death rates largely due to limited access to maternal and emergency obstetric care, and ruining of vaccines due to poor cold chain services (WHO, UNICEF and World Bank, 2009).
- Off-grid renewable energy solutions represent a huge opportunity to expand electricity to rural health centres today, without waiting for other solutions. The magnitude of this development opportunity came across strongly at IOREC 2016, with practitioners highlighting the development impact of off-grid renewables. In the case of a project in Tanzania, since solar panels

were installed in 2013, infant mortality rate decreased over 35% and the number of children being vaccinated increased from a baseline of 40 per cent to 90 per cent (Garder, 2015).

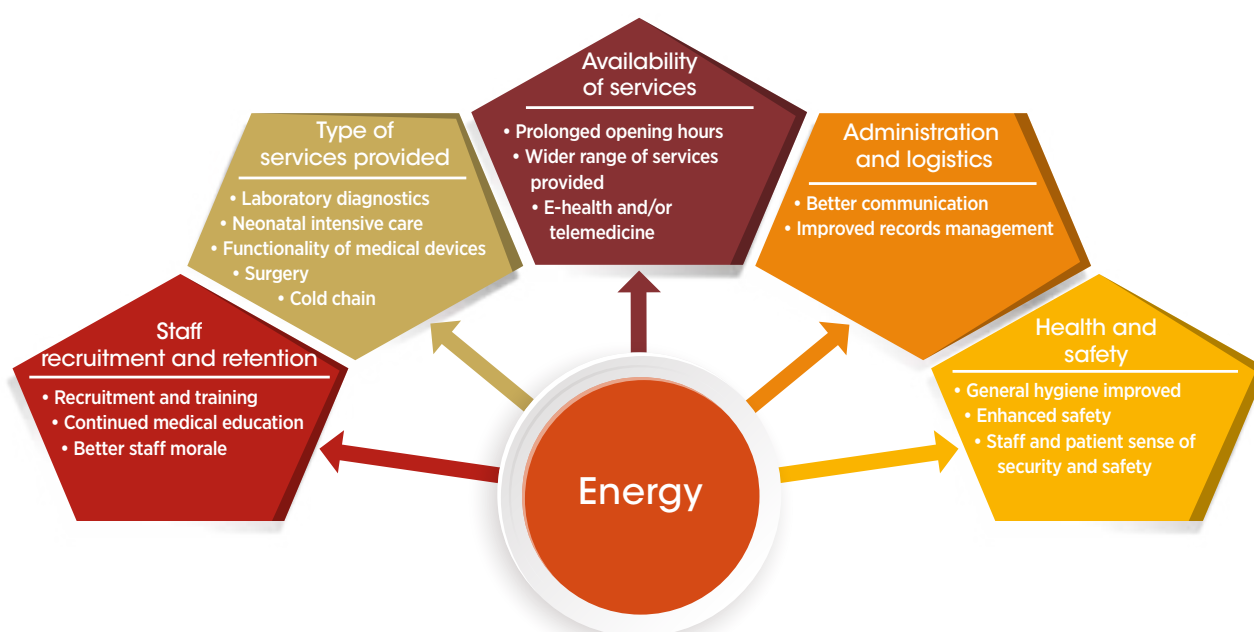
- Realising these opportunities requires increased cooperation between ministries in charge of health and energy. One example of institutional collaboration is the recent signing of MoU between the Council for Energy, Environment and Water and the Indian Council for Medical Research to jointly work towards electrifying primary health centres in India using solar technology (PIB, 2016). This builds on earlier work conducted to assess and quantify energy demand in rural health centres and suitability of off-grid renewables (CEEW and Oxfam, 2016).

"Immediate development benefits to come from prioritisation of health facility energy needs."

Michaela Pfeiffer, Technical Officer, WHO

- Electrification of rural health centers should be a priority in all rural electrification strategies and budget should be allocated accordingly. Furthermore, allocation should reflect the full cost for maintaining the systems and for replacements (e.g., batteries).

Figure 3 Importance of energy to health services



Source: Adapted from WHO at IOREC

➤ **Off-grid renewables for agriculture:**

Agriculture and agri-food related activities are at the heart of rural economy, therefore, growth in the agriculture sector is among the most effective ways for poverty alleviation. Introducing off-grid renewable energy technologies along different stages of the agri-food chain to deliver affordable, secure and environmentally sustainable energy can boost productivity, reduce losses and increase resilience to climate variability. IRENA and GIZ jointly organised two side events at IOREC 2016 – *Off-Grid Renewables in the Agri-food Chain: Supporting Measures and Benefits* and *Solar Pumping for Irrigation: Developing the Ecosystem to Maximise Benefits* – to disseminate findings from recent analysis on the topic and to discuss measures needed to scale up the deployment of off-grid renewables in the agri-food sector. Participants recognised the opportunities and shared their experiences with projects and described their impacts. To facilitate deployment, the following key points were highlighted:

- Coordination between agriculture and energy stakeholders to collectively identify deployment opportunities and put in place supportive measures that contribute to meeting development objectives of both sectors.
- Capacity building focusing on both the technology as well as market access, especially in cases where the viability of off-grid renewable energy interventions is linked to farmers' ability to access markets for their produce.

- Access to finance for technology and service providers (especially during early stages of technology demonstration and scale-up), as well as end-users (e.g., low-cost, asset-based financing for farmers) should be facilitated.

"If you bring energy services to a village without other services (agriculture, health, education, productive uses), it's like delivering a new car without fuel."

Aaron Leopold, Global Energy Representative,
Practical Action

Renewable Energy Benefits: Decentralised Solutions in the Agri-food Chain is IRENA's first interactive digital publication which analyses the socio-economic impacts of deploying off-grid solutions in the agriculture sector (IRENA, 2016c). Launched at IOREC 2016, the report finds that the use of off-grid renewables along different segments of the agri-food chain can generate considerable time and economic savings as well as improve output.



- It is essential to integrate the socio-economic aspects of off-grid solutions in assessments. In addition to energy generation, assessments need to evaluate what steps can be taken to utilise the energy to create greater socio-economic impact. Evaluations should not be limited to the operational hours of appliances but instead strive to be more holistic and practical, for example considering, in the case of health centres, if medics are present and whether maternal and infant mortality has decreased.



Source: InnovationAfrica



Source: UNEP/Marc Lee Steed



Renewable energy and the Sustainable Development Goals (SDGs)

Renewables are key to the goal of ensuring “access to affordable, reliable, sustainable and modern energy for all” included in SDG 7 – one of the 17 SDGs adopted in 2015 by the international community as part of the 2030 Agenda for Sustainable Development. Meeting SDG 7 on energy reinforces a wide range of other key goals. Renewables contribute to environmental sustainability, create conditions to further human development by facilitating access to basic services, improving human health and enhancing incomes and productivity. Renewables also create new jobs and spawn new local industries. IRENA’s latest edition in its *REthinking Energy* series presents an in-depth analysis on the linkages between renewable energy and SDGs (IRENA, 2017).

FINAL THOUGHTS

Universal access to energy is, as we have seen, a development imperative, enshrined in the UN's 2030 Sustainable Development Goals. We know that reliable off-grid energy saves the lives of mothers and infants, catalyses rural communities, transforms livelihoods, and creates more sustainable environments. Yet the pace of expansion threatens to leave as many as 600 million without the hoped-for access by 2040. In this paper, we have provided eight key messages from the 2016 IOREC gathering in Nairobi:

1. Mainstreaming off-grid renewable energy in national rural electrification strategies.
2. Creating an ecosystem to accelerate deployment.
3. Designing dedicated policies and regulations.
4. Unlocking capital for energy access.
5. Identifying the right business models for deploying off-grid renewables.
6. Innovating to improve accessibility, reliability and range of electricity services.
7. Strengthening sustainable energy access and maximising benefits.
8. Harnessing the cross-sector development impact of off-grid renewables.



100 kilowatt (kW) micro-grid in Dharnai in Bihar (India)
Source: Greenpeace

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