

ACCELERATING OFF-GRID RENEWABLE ENERGY

IOREC 2014:

KEY FINDINGS AND
RECOMMENDATIONS

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The International Renewable Energy Agency (IRENA) is an intergovernmental organisation that supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, 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.

Acknowledgement

The second International Off-Grid Renewable Energy Conference and Exhibition was jointly organised by IRENA, the Asian Development Bank and the Alliance for Rural Electrification.

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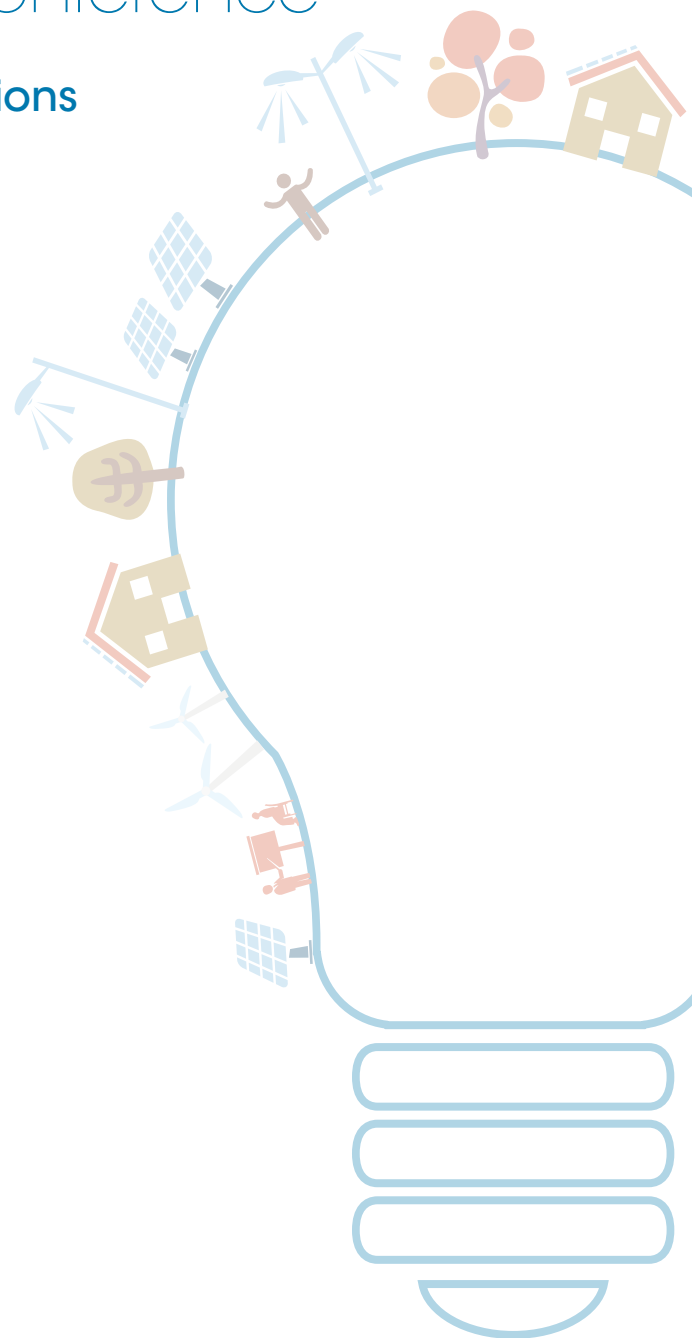
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Accelerating Off-grid Renewable Energy

IOREC 2014

Second International Off-Grid Renewable Energy Conference

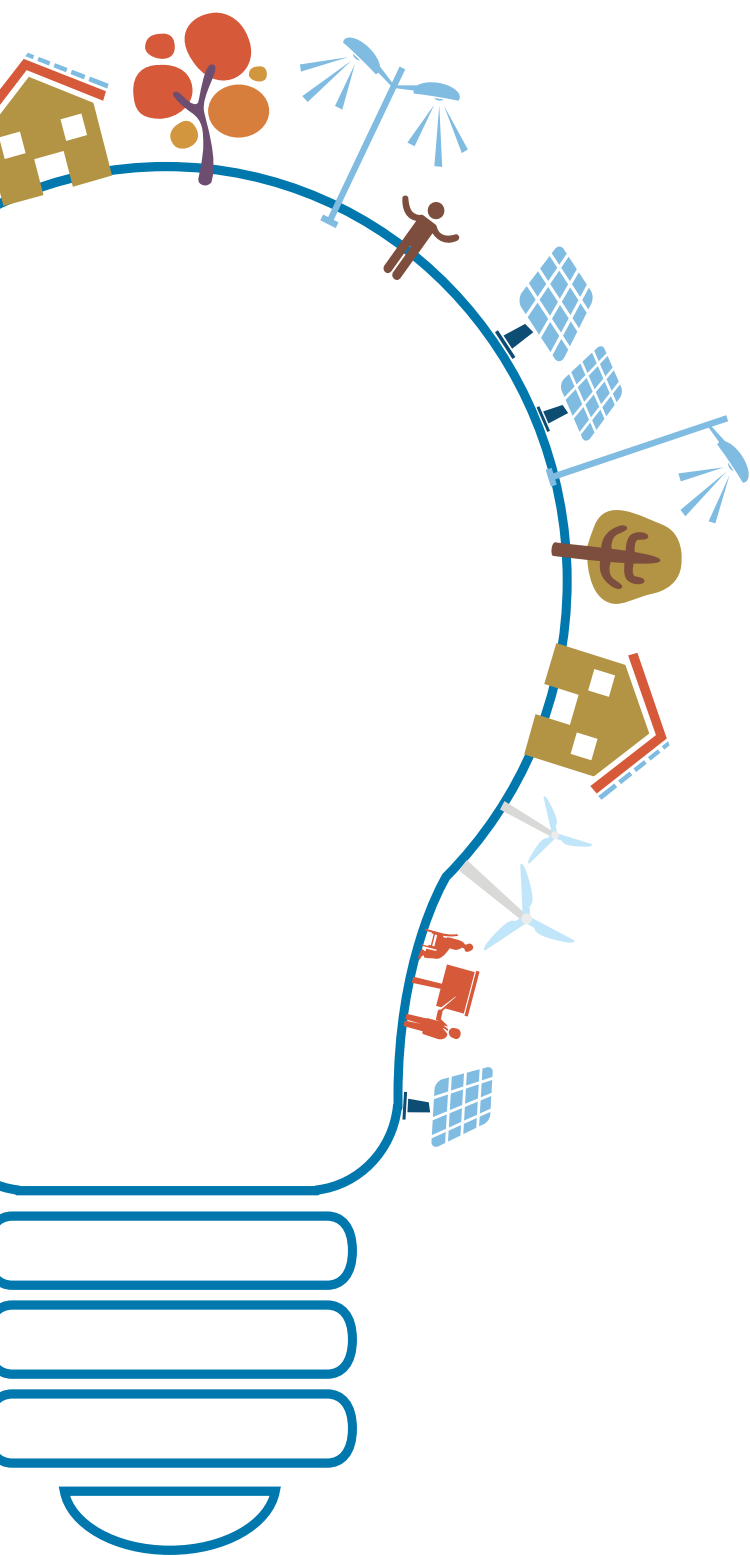
Key Findings and Recommendations



Contents

ABOUT THE REPORT	7
OPENING REMARKS	8
SESSION 1	11
Developing markets for stand-alone renewable energy systems: insights into policy and regulatory aspects	
SESSION 2	18
Developing markets for stand-alone renewable energy systems: insights into financing and business models	
SESSION 3	24
Socio-economic impact of off-grid renewable energy deployment: meeting basic and productive needs	
SESSION 4	31
Developing markets for renewable energy-based mini-grids: insights into policy and regulatory aspects	
SESSION 5	37
Developing markets for renewable-energy based mini-grids: insights into financing and business models	
SESSION 6	42
Financing energy access initiatives: mobilising finance and establishing the right delivery mechanisms	
SESSION 7	48
Off-grid renewable energy technology: design, innovation and integration	
CLOSING REMARKS	55
ANNEX 1	57
Conference Agenda	

About the Report



The International Renewable Energy Agency (IRENA), the Asian Development Bank (ADB) and the Alliance for Rural Electrification (ARE) co-organised the Second International Off-Grid Renewable Energy Conference and Exhibition (IOREC) in Manila, Philippines, on the 16-17 June 2014. The conference convened over 400 key stakeholders from across the off-grid renewable energy value chain, including representatives from rural electrification agencies, ministries in charge of renewable energy development, the private sector, academia, financing institutions and international organisations. This paper presents the main outcomes from the discussions that took place during the two-day conference as well as the results of the IRENA survey that was conducted among 423 stakeholders from South and South-East Asia. Conference videos and presentations are available on the IOREC website, www.iorec.org.

Opening Remarks

Adnan Z. Amin

Director-General, International Renewable Energy Agency (IRENA)

There is no doubt that access to clean and reliable electricity is vital for social and economic development. Sustainable energy is at the core of sustainable development discussions and is increasingly emerging as a central pillar in deliberations on the post-2015 development agenda. Achieving universal access to electricity requires a combination of grid-based and off-grid solutions. Without that approach, the broader objectives of all-inclusive sustainable development cannot be met.



Nearly 60% of the additional generation required to achieve universal electricity access needs to come from off-grid solutions – both stand-alone and mini-grids. IRENA's work on Renewable Power Generation Costs concludes that renewable energy technologies are increasingly cost-competitive and are now the most economic option for off-grid electrification in most rural areas. They can be significantly cheaper than diesel-fired generation or kerosene-based conventional lighting, which are dominant sources of expensive and unclean electricity in many rural areas. Decentralised renewables present an immense opportunity to expand clean, reliable and cost-effective electricity access in rural areas.

Tapping into this vast potential will require collective efforts to create an enabling environment that supports the scale-up of energy access efforts through private sector participation. This includes adopting an effective policy and regulatory framework, along with tailored business and financing models and adapting technologies to the rural context. If the enabling environment is appropriate, off-grid solutions can be deployed rapidly to extend electricity access for meeting basic needs but also for promoting

productive uses. Bangladesh, with the world's largest deployment of solar home systems - 2.6 million by the end of 2013 - is a case in point. Amazingly, Bangladesh's solar home system programme deployed 280 000 solar home systems in the six years between 2002 and 2008, and today it deploys the same number in under five months.

The business case for deploying off-grid renewables in rural areas has never been stronger, and innovative business models are emerging to underlie growth in the sector. We are also seeing a tremendous case for off-grid renewable energy solutions for island countries, which are often saddled with the high costs of imported fossil fuels but are blessed with renewable energy resources. IRENA's Lighthouses initiative is supporting island countries in their transition to a renewables-dominated energy system through the formation of local and regional partnerships, as well as engagement with the international community.

Beyond the energy industry, there are striking synergies between rural electrification and other sectors critical to human development. Access to electricity can improve the accessibility and reliability of the water supply, facilitate extension of basic rural healthcare services and enable the outreach of telecommunication services in rural or island contexts. This presents a compelling case for policy-making to adopt a more holistic approach to energy access and to include it as a means of stimulating economy-wide development and as a pathway to fight poverty.

Platforms such as the International Off-grid Renewable Energy Conference are instrumental in allowing for the sharing of experiences from expanding modern energy services and leveraging on these experiences to collectively identify solutions to the off-grid renewable energy deployment barriers. Such a collaborative approach will be central to our ability to meet the development objectives that we set out for ourselves as a global community.

Wencai Zhang

Vice President, Asian Development Bank

Energy access and clean energy are key areas of the Asian Development Bank's (ADB's) work and policy. Renewable energy and off-grid energy access are closely linked issues – a recent connection made possible by great advances in renewable energy and



a deeper understanding of energy poverty. For decades, ADB, our partner organisations and national governments have prioritised extending national energy infrastructure grids. This investment has benefited millions of people, but millions remain unserved. The International Energy Agency (IEA) estimates that 615 million people in Asia and the Pacific are still without electricity access. The grid has geographical and financial limits, and few utilities can afford to extend lines to remote rural areas. But it is people in these areas who will benefit most from modern energy access.

As part of ADB's mandate to fight poverty in Asia and the Pacific, we place great emphasis on maximising energy access for the poor and supporting clean energy in Asia. This is part of our official stance, as laid out in our Long Term Strategy 2020 and our current energy policy, established in 2009. Our Energy for All initiative and Clean Energy Program lead our efforts in this area. Off-grid renewable energy is the intersection of ADB's priorities in renewables and energy access. The potential to reach and benefit millions with access to modern energy is a chance that cannot be passed on, and placing people on a low-carbon path of development at an early stage allows them to leapfrog the need to rely on high-carbon sources of energy.

ADB's investments in energy access and renewables demonstrate our commitment. Since 2010, our annual investment in energy access projects

has been at least USD 900 million. In 2013, we invested over USD 980 million dollars in energy access. Between 2008 and 2012, ADB's completed projects extended new power projections to over 4 million households across the region. Our clean energy investment has been just as solid. Since 2011, ADB has surpassed USD 2 billion annually in clean energy investment, covering both renewable energy and energy efficiency. Last year, we invested USD 2.3 billion.

Clean energy is a win-win solution to the dual challenges of energy security and climate change. As technology has advanced, it is also an off-grid solution. ADB supports any technology as long as it is proven and helpful. Our investment has gone to mini-grids, solar home systems and community-scale hydropower. But for long-term, sustainable solutions, we are looking at entrepreneur models. We are partners with well-known institutions, such as SELCO, a social enterprise in India that supplies solar home systems and that trains and supports energy access entrepreneurs. We are also supporting upcoming businesses through private equity investments in innovative areas such as pay-as-you-go solutions for electricity access. Through our Energy for All initiative, we are developing projects, offering mentoring and connecting access proponents with investors to help them expand and scale up the operations.

At the opening of the Asia Clean Energy Forum 2014, ADB's role as a regional hub for the global Sustainable Energy for All (SE4ALL) initiative will be formalised. This effort seeks transformative change for increasing the share of renewables, increasing energy efficiency and ultimately achieving universal energy access by 2030. The growth of renewables, advances in renewable energy technology and renewed focus on ending energy poverty are all aligned to make off-grid energy solutions the next major area at which government and the private sector will be looking. It presents an exciting prospect.

Ernesto Macías

President, Alliance for Rural Electrification

Thanks to pioneers that began working in this sector 30-40 years ago, the off-grid sector has now come of age. The last few decades and even since the last IOREC in Ghana, we have experienced a dramatic change in the sector. Defying many projections, off-grid renewable energy solutions now represent a stable solution. This is a major step change for the Alliance for Rural Electrification (ARE), an international business association that I have led over the past eight years, which engages with the private sector involved in the rural electrification sector.



At ARE, we work closely on the ground – our members are in countries, deploying technologies and garnering knowledge on what works and what does not. We are providing solutions for not only installing off-grid renewable energy systems, but also managing them. The sector has transitioned from being funded primarily by non-governmental organisations (NGOs) and charities, to one where electricity access is being provided through a private sector-driven initiative with a financing model that must be sustainable to provide step-by-step energy solutions to communities. It is not just a question of supplying electricity, but of stimulating rural economies by catering to the energy needs of agriculture, industry and local businesses.

The challenge for the global community is to exchange information on technology, improvements in business models and other critical issues that are absolutely key to securing universal access to

modern energy services. It is very clear that we, together with many other stakeholders, are a global platform for sharing this knowledge, and identifying best practices for rapid implementation is one of the key issues. We are working very closely with institutions like IRENA, the World Bank, the United Nations, the European Commission and many foundations to facilitate the schemes and business models that work. We are also strongly committed to the SE4ALL initiative, trying to participate and cooperate to achieve a vision that most find difficult to believe: that electricity access in isolated areas will be delivered through off-grid solutions.

Research and development is absolutely key to ensure that the technology is continuously updated to adapt to changing local conditions, and that these developments are shared within the market. A key problem facing some projects is the time lag between a project's design and its implementation. Technology costs as well as the technical solutions available are changing rapidly to the benefit of the energy poor. It is important to work with governments to establish easier and quicker systems to utilise the money available to implement solutions in a timely manner. If the time lag is too long, some of the solutions may no longer be valid and may be rendered obsolete.

Off-grid solutions are highly relevant for South-East Asia, given the vast number of islands in the region. We are increasingly seeing renewable energy solutions being deployed on islands, and the argument for their adoption has diversified from climate change mitigation. Renewable energy-based solutions now present a compelling business case and often represent the most suitable solution for providing electricity.

Session 1

Developing markets for stand-alone renewable energy systems: insights into policy and regulatory aspects

KEY ACTION POINTS

- » Governments need to commit to the off-grid renewable energy sector and introduce measures that contribute to the development of a market; these may include laying out a realistic plan, abiding by it with stable and predictable policies, providing targeted support, rethinking subsidy mechanisms for fossil fuels and fostering innovation.
- » Engagement with local actors who are undertaking the ground work – setting up businesses, securing financing and developing projects – needs to be increased along various stages of sector planning and decision-making processes.
- » Adequate mechanisms for financing off-grid projects need to be explored that can effectively mobilise and deliver the necessary financial resources to the far reaches of rural enterprises and communities. Public financing will continue to play an important role in de-risking investments and leveraging private capital – a necessity for the desired scale-up of the sector.
- » International and national agencies can play an important role in increasing local governments' awareness, in providing technical assistance as well as in addressing financing needs. At the same time, it is very important for the countries themselves to have ownership in deciding where they should use the support.
- » Governments need to address the administrative challenges facing the private sector. These challenges include complicated or unclear processes for disbursing support, lack of tailored policies, lack of co-ordination among different institutions and corruption.

The first IOREC session focused on the critical question of what market-creating measures governments need to introduce to support the development of an enabling environment for scaling up off-grid solutions based on renewable energy. The session attempted to decode the role of governments in facilitating the large-scale diffusion of stand-alone systems, which thus far has been limited to specific projects or markets.

Salvatore Vinci from IRENA set the scene by presenting the key outcomes from the first IOREC conference, held in Accra, Ghana, in November 2012. The session moderator, Kandeh K. Yumkella, Special Representative of the United Nations

Secretary-General and Chief Executive of the Sustainable Energy for All initiative, then opened the discussions by reminding the audience of the 2030 targets for the global community, among them achieving universal access to modern energy services. A market-driven approach to off-grid renewable energy deployment is key to meeting the target of universal electricity access in a timely and sustainable manner. The private sector will bring the technology, financing and product innovation. But governments have an important role to play in ensuring that the appropriate environment is established for private sector investment, thereby accelerating the expansion of modern energy services in a financially sustainable manner.

Beginning with Bangladesh: the success story of the world's fastest growing off-grid electrification programme

Bangladesh is at the forefront of the off-grid renewable energy transformation. It is the world's fastest growing off-grid electrification programme, deploying over 65 000 solar home systems a month, with average year-on-year growth of nearly 60%. The programme now reaches a total of 13 million people, or 9% of Bangladesh's population, and has driven the development of a robust domestic industry that employs nearly 70 000 people. More importantly, it has demonstrated that electrification programmes targeted at poor communities can in fact be scalable and sustainable. An important question to address is: what is behind the success of the programme, and can it be replicated across the region?

Farzana Rahman, Unit Head (Investment) at Infrastructure Development Company Limited (IDCOL) Bangladesh, highlighted the fact that *"there are various components that need to be in place to make an off-grid electrification programme successful"*, but emphasised the importance of policy and regulatory aspects for proper functioning of the sector. In particular, the government in Bangladesh recognised off-grid renewable energy as an effective option to expand electricity access, and it relies on public-private partnerships to rapidly scale up the deployment of off-grid solutions. It does so through IDCOL, a government-owned financial institution which, along with 48 partner organisations (primarily micro-finance institutions and NGOs), manages the country's very successful solar home system programme.

The government's efforts at establishing the right environment for technology adoption – setting renewable energy targets, introducing fiscal incentives and allowing implementing agencies operational autonomy – are increasingly mobilising the private sector in project development and product innovations. A private sector player from the audience summed it up: *"Our recommendation is that policy regulation is good, but give it to independent agents like IDCOL. Give them the money, give them the framework, let them engage in the dialogue with the private sector and make it happen."* Benefiting from this positivity, IDCOL is expanding its electrification programmes beyond solar home systems to mini-grids and irrigation pump sets. It is targeting 6 million solar home systems by 2016, 1 550 solar irrigation pumps, 50 mini-grids and 450 bio-electricity plants

by 2016. Reacting to the set targets, Rahman stated: *"We don't see it as much of a challenge if all the enabling policy and regulatory aspects are in place."*

Looking back at the pre-IDCOL days of market development for solar home systems led by Grameen Shakti (now one of IDCOL's partner organisations), what really worked for Bangladesh was the fruitful co-operation between NGOs and local private companies. Dipal Barua, Former Managing Director of Grameen Shakti, highlighted that *"we need to bridge the gap between the people without electricity and financing institutions"*. The pre-existence of a vast network of micro-finance institutions in Bangladesh served just that purpose.

The proliferation of micro-credit over the last 20 years, with Grameen Bank at the forefront, means that business models for off-grid electrification evolved around that infrastructure and branding.

When the models succeeded, and when processes were standardised and a sufficient scale was reached, external actors, such as the World Bank, entered the market with the financial support needed for the next phase of expansion, which has gotten the programme where it is today. These conditions – the advantage of a micro-financing network, the entrepreneurial nature and character of the communities and high population densities – are unique to only a few markets. In this context, Andy Schroeter, Director of Sunlabob Renewable Energies in Laos, stated: *"Bangladesh and India have different conditions. When I hear these numbers – 2.6 million, 3 million solar home systems – amazing, amazing, amazing. For us in South-East Asian countries, the conditions are different."*

Recognising the contextual differences and integrating off-grid systems into national electrification strategies

South-East Asia has different conditions than Africa or Central Asia or South Asia. The sector over the last few decades has seen significant activity from global donor agencies. Schroeter observed that many of these programmes failed, noting: *"When we analyze the rural electrification projects, we see in Laos that at least 65% of the solar home systems are out of order."* Contributing factors have included, in many cases, a lack of focus on design, maintenance, after-sales services and capacity building. International consultants come in with standardised designs for products, business models and policies that are not compatible with the local market conditions.

Jiwan Acharya, Senior Climate Change Specialist at ADB, agreed: *“The problem [of energy access] is much more complex than it appears. The biggest problem is that the situation of every country is different. We cannot just take one solution, one example, from one country to another. Often we fail because we simply try to replicate the same model without really understanding the situation. Bangladesh’s IDCOL model is very successful, and there is a lot we can learn from there, but we also need to look at the unique realities in different countries.”*

“Bangladesh’s IDCOL model is very successful, and there is a lot we can learn from there, but we also need to look at the unique realities in different countries.”

The operational challenges cannot be ignored either. Operations costs are higher in sparsely populated countries, thereby challenging sustainability of business models. Ensuring that adequate after-sales services infrastructure is in place is yet another operational challenge. Bangladesh’s IDCOL model, for example, has a robust, rather resource-intensive but necessary, quality assurance mechanism comprising year-round door-to-door inspections.

Governments also vary widely in their political commitment towards the sector. In some cases, government rural electrification solutions are directed solely at large infrastructure efforts. There is general agreement that achieving universal electricity access will require the adoption of both on- and off-grid approaches. For a specific region, a technical and economic evaluation must guide the choice of the electrification approach. The costs of off-grid solutions need to be seen within a broader framework than just at the project level. When evaluating the economics of off-grid solutions, the real cost of grid extension needs to be considered, including costs associated with building centralised capacity, importing fossil fuels, operating plants and subsidising electricity provision to rural areas (where applicable).

Several ongoing initiatives are assisting governments with this planning. In Myanmar, for example, ADB and the World Bank are helping the government plan where grid extension is more feasible, where mini-grids are optimal and where individual household systems are more appropriate. Governments need to take the lead and be active, not passive, actors in

the sector. They need to understand that access to electricity is part of a broader solution that includes stimulating local development, job creation and setting in motion a transformation of rural economies.

Changing mindsets: a shift away from grant-based approaches

A shift in mindsets is needed away from a purely grant-based approach and towards more sustainable business models. Traditionally, non-governmental energy access initiatives in off-grid areas were mostly grant funded. Today, however, cost-competitive alternatives exist. Dipal Barua, one of the pioneers of Bangladesh’s success, testified to this fact: *“For the cost of kerosene, you can buy a solar home system. Before, we were buying a panel for USD 7 per Watt. Now, we are buying panels for less than USD 1 per Watt.”* The technology now exists and is cost competitive with traditional lighting solutions such as diesel and kerosene.

What, then, is hindering the sprouting of sustainable businesses to tap into this massive market? Jiwan Acharya provided the first clue: *“We are often dealing with poor people, very poor people in remote and rural areas. We need to look at the business models very differently than dealing with a wind farm, for instance, where the conditions are very different.”* Developing actual business-driven projects requires soft support, patience and a lot of helping hands. This support includes identifying entrepreneurs who have good business propositions, providing assistance in developing these projects using a proper format and template, doing feasibility studies and helping project recipients undertake pilots and attract investment.

So what role can governments play in all this? Hardiv Harris Situmeang, Executive Director of the ASEAN Centre for Energy, summed it up well for governments: *“Establish the legal framework; properly set up a tariff for off-grid electrification; avoid providing subsidies where market-based rural electrification approaches are feasible; allow for long-term agreements between public and private partners; and avoid political interference in selecting the business model for off-grid rural electrification projects.”* Overall, the government needs to create an environment that allows local businesses to thrive, without which a scale-up would be impossible. These findings were also reflected in IRENA’s online survey¹ wherein the private sector highlighted what measures government

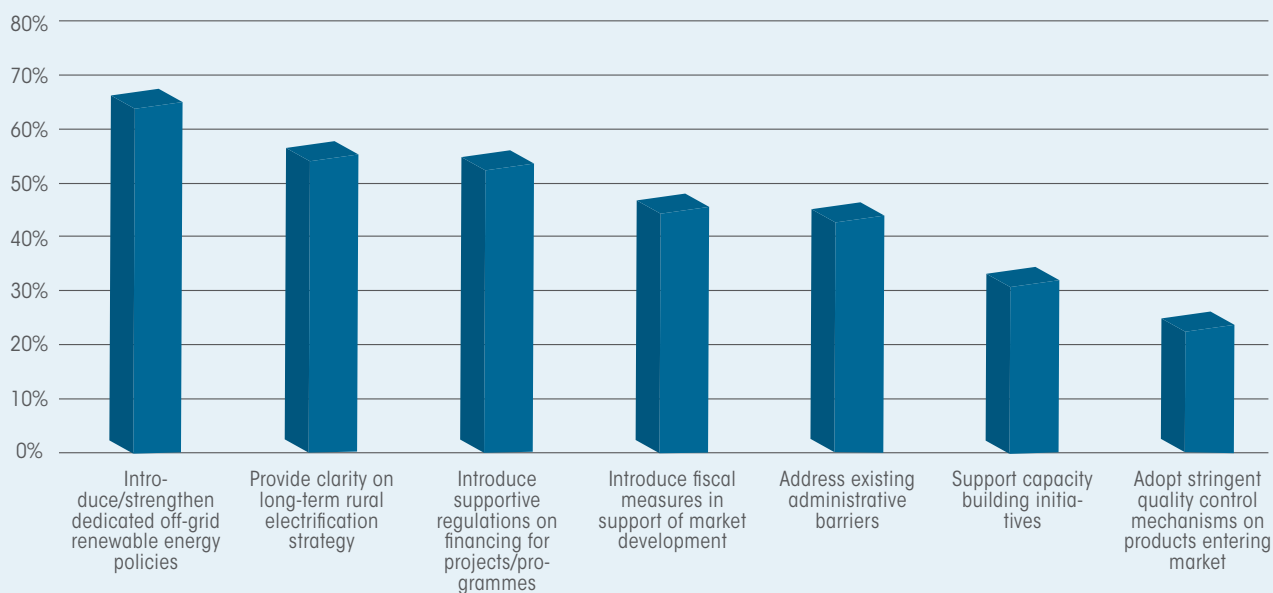
need to take to support off grid renewable energy deployment (see figure 1).

Dr. Yumkella noted that pricing will be a big question moving forward, as this directly affects the sustainability of private sector-led initiatives in the off-grid renewables sector. Giving a private sector perspective on the matter, Andy Schroeter emphasised that: *“The general problem is: how can you come up with a commercially viable, sustainable business model for off-grid electrification in a country where the tariff for grid electrification is heavily subsidised? How can we become commercially viable? It’s impossible.”* Vijay Iyer from the World Bank insisted on also looking at it from a policy maker’s perspective: *“The issue of subsidy is a very crucial one. However, this is a perennial dilemma for the policy maker.”*

Iyer noted that policy makers have to see how they can balance energy prices with other

prices, so that the overall services that industries and consumers need can be obtained at a reasonable cost. So, the idea would be to see how certain entry points for off-grid electrification can be subsidised in order to level the playing field. The Bangladesh example is a good model, utilising very smart, targeted subsidisation, as well as grant making, to cover certain aspects of the costs to the private sector that are very high, such as setting up distribution channels for solar products, and finding ways to subsidise quality assurance so that producers and consumers have good information about the quality of products. In the absence of such an environment, many private sector players, exasperated by years of investments and scaling-up efforts, are looking beyond traditional public-private partnership models. The new direction for Sunlabob, for instance, has been to find anchor clients for commercially viable business models. In Myanmar, investments in 18 000 off-grid towers will take place in the next five years, potentially in the

FIGURE 1. PRIVATE SECTOR PERSPECTIVE: WHAT ARE THE TOP MEASURES THAT GOVERNMENTS SHOULD TAKE TO SUPPORT OFF-GRID RENEWABLE ENERGY DEPLOYMENT? (% OF TOTAL RESPONDENTS*)



*RESPONDENTS COULD CHOOSE UP TO FOUR ANSWERS

¹ IRENA conducted an online survey to assess the state of the off-grid renewable energy sector in South and South-East Asia and to identify key barriers and solutions for sector development. A total of 423 responses were collected from stakeholders in the region, including project developers, equipment manufacturers, financiers, policy makers and regulators, academics and researchers, among others.

44 000 villages that are home to many of the country's 40 million people without electricity. The stability of an anchor client provides the much needed de-risking that can then be leveraged to secure financing from more mainstream sources and contribute to bridging the significant gap that presently exists.

Where is the financing?

Access to financing remains a fundamental challenge for the private sector working in the field. There has been a long-standing divergence in viewpoints of the financiers and the private sector. Development banks often cite the availability of financing as a non-issue, saying that it is just a question of developing processes to deliver that money to those on the ground. But the private sector asserts that financiers have been sending this consistent message for decades. Schroeter highlighted that: *"We have had a gap in understanding for decades. We are speaking a different language. The global donor agencies, or the financing institutions, speak completely differently from the people at ground level who are doing the real work."*

The development bank on the panel, ADB, clarified that: *"Money cannot flow just like that. We need to have a case. We have to be sure that the money goes to the right people, that it goes through the right channel, that procedures are followed properly. So this is where on the one hand money is needed, and on the other hand where money is not being spent."*

The scale-up in deployment necessary to meet the target of universal electricity access will require at least five times more investment than the sector attracts today. Vijay Iyer from the World Bank highlighted that the financing challenge in the off-grid sector boils down to the issue of aggregation. Impact investors, or institutional investors that may be interested in the sector, are unwilling to bear the transaction costs of relatively small investment tickets. There is a need to identify mechanisms for addressing this challenge, either through aggregation of projects to attract investments from non-traditional players or by establishing frameworks that pool funding and make it accessible for small projects in an effective and sustainable manner.

There is agreement within the off-grid sector about the important role that public financing can play in scaling up electricity access efforts. Several models exist for deploying such financing,

either on a project-by-project basis, within a public-private partnership framework or through the provision of affordable financing. In either case, the private sector often reports high transaction costs in accessing public financing – which hampers, rather than supports, sustainable business models. IRENA Director General Adnan Z. Amin challenged the governments and the broader financing communities: *"What we need is a new type of solution for how we put public finance in the hands of entrepreneurs with the right accountability frameworks. Is there a way that we can start creating a framework so that public finance can actually flow to the people who need it, in the time frame that they need it?"*

"What we need is a new type of solution for how we put public finance in the hands of entrepreneurs with the right accountability frameworks. Is there a way that we can start creating a framework so that public finance can actually flow to the people who need it, in the time frame that they need it?"

In some of the countries in the South- and South-East Asia region, even though public financing is allocated for supporting off-grid electricity access, the funds have not been fully utilised even though many small businesses and projects are starved of the right type of funding. Challenges hindering the effective and timely utilisation of finance include procedural problems with disbursement and political instability. Where funding does not exist, local governments are tasked with identifying how it can be secured. A representative of a local public institution in the audience presented his own experience: *"The problem here is flow of information from the financiers to the recipients. Our local governments don't have any idea where to get the money for competitive financing."* These gaps need to be addressed, because central to any sustainable business model is access to affordable financing. With respect to governments, Schroeter brought up an often avoided, but necessary, additional element: *"We never talk about corruption and bribery. This is what we don't want to talk about, but it also has an effect [on sustainability of business models]."*

Looking beyond lighting, and enabling productive activities

Energy is simply a means, not an end in itself. Ernesto Macías, President of ARE, insisted: *"Providing light is*

not enough. I would say it's good in some of the cases, but we need to move the supply of power forward for a great, real step in countries' development." Whether energy is used for income generation, health, education or any other activities, we have to ensure that those uses are there so that people will actually benefit from it. This necessitates an understanding of the local environment and conditions. As Marcus Wiemann, Secretary General of ARE highlighted: "It's not to pour money from the top down. In the end, the multiplier, the leverage of what we want to achieve, are the people themselves. If they find good reasons to engage in rural energy business and make a living out of it, this will all certainly happen."








"Governments have an important role to play in supporting the creation of markets that are conducive to private sector participation."

Andy Schroeter pointed to the importance of a holistic approach when discussing productive uses of energy: "Productive use sounds good on paper. It also means talking to off-grid communities who have no clue what to do with energy, thus requiring a more holistic approach. We also need people, ideally NGOs, which focus on demonstrating to people the income-generating activities that

electricity access can enable." As such, income generation cannot be considered imminent once electricity access is achieved. Jiwan Acharya highlighted: "Looking at the evaluations of some of these individual household systems – the productive use part, especially when it increases their income – we have some cases here and there, but it hasn't been that much." Productive uses of energy require more power and a more reliable supply of electricity, thus making mini-grids particularly suitable for these uses.

Concluding remarks

Dr. Yumkella concluded the session by reiterating the challenging task that lies ahead of us. The business-as-usual scenario is clear: despite all the dynamism and successes, nearly a billion people will still be living without electricity access in 2030. This is unacceptable from a social, economic, development and political point of view. The solutions are there, including good examples of technologies, business models and public policies that are making inroads in reducing energy poverty in many countries. Stakeholders need to learn from each other to create a knowledge system that can help share best practices and support countries in formulating the right policies. Governments have an important role to play in supporting the creation of markets that are conducive to private sector participation.

MODERATOR	PANELISTS					
 <p>Kande K. Yumkella Special Representative of the UN Secretary-General and Chief Executive for the Sustainable Energy for All initiative</p>	 <p>Salvatore Vinci Programme Officer Policy Advice, IRENA</p>	 <p>Hardiv Harris Situmeang Executive Director, ASEAN Centre for Energy</p>	 <p>Farzana Rahman Unit Head (Investment), Renewable Energy, IDCOL, Bangladesh</p>	 <p>Marcus Wiemann Secretary General, Alliance for Rural Electrification</p>	 <p>Jiwan Acharya Senior Climate Change Specialist, Asian Development Bank</p>	 <p>Andy Schroeter Director, Sunlabob Renewable Energies, Laos</p>

Session 2

Developing markets for stand-alone renewable energy systems: insights into financing and business models

KEY ACTION POINTS

- » Despite being cost competitive on a life-cycle basis, the relatively high capital-to-operational cost ratio compared to conventional systems continues to be a key barrier for stand-alone renewable energy systems. Overcoming this requires access to end-user financing that is tailored to the consumers' income, cash flow and current expenditures on energy services (e.g. kerosene or candle lighting, mobile charging).
- » An ecosystem of energy financiers to deliver downstream financing is of crucial importance. This involves dedicated lines of affordable credit for energy enterprises, ideally within rural banks, commercial banks, etc.
- » Continuous technological upgrades and innovation are key. Off-grid solutions need to be customised to local conditions to ensure long-term operation. Localising parts of the distribution value chain helps better adapt services to local demand, while also bringing down costs.
- » Sustainability of business models is impacted by market distortions, such as kerosene subsidies, which need to be adequately considered when promoting off-grid renewable energy.
- » To ensure sustainability, business and financing models also need to account for resources for conducting operations, maintenance and after-sales services of systems.

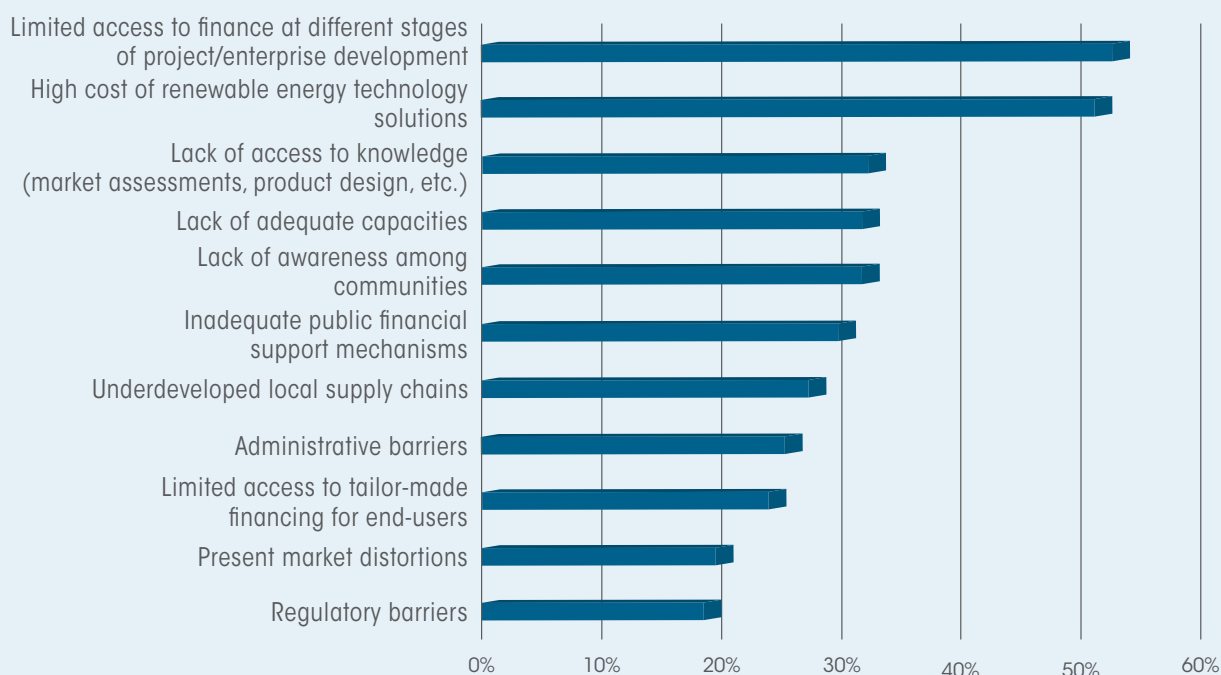
The imperative of moving towards a market-based approach for scaling up stand-alone renewable energy solutions was a clear takeaway from the first session. The moderator of the second session, Akanksha Chaurey, CEO of IT Power India, began by illustrating the paradigm shift that the sector has experienced over the past decade or so. Nowadays financing for the sector is discussed, not funding. Business models for stand-alone technologies have evolved from NGO-driven to increasingly private sector-led initiatives. But critical questions remain regarding how to achieve a substantial scale-up moving forward:

- » How can markets be developed in the first place to support sustainable business models?

- » What constitutes a business model that is sustainable and scalable, both of which are much-desired characteristics today?
- » How does financing play into the equation of developing markets and business models?

The session brought together the key stakeholders – the private sector, development financing institutions and a foundation – to attempt to answer some of these questions and to discuss the key barriers (also highlighted in IRENA's regional stakeholder survey; see Figure 2) that need to be addressed to scale up the deployment of stand-alone renewable energy.

FIGURE 2. WHAT ARE THE LARGEST BARRIERS THAT HAMPER DEVELOPMENT OF THE STAND-ALONE RENEWABLE ENERGY SECTOR? (% OF TOTAL RESPONDENTS*)



*RESPONDENTS COULD CHOOSE UP TO FOUR ANSWERS

The needs exist, but markets need to be developed

The potential market for off-grid solutions already exists. Rural households are spending substantial amounts of money, an estimated USD 37 billion annually, on accessing conventional lighting solutions such as kerosene and candles. In life-cycle terms, there is no doubt that stand-alone renewable energy solutions, such as solar home systems, are cost competitive with the conventional options. What, then, keeps private companies from tapping into this market? The answer lies in getting the fundamentals of market development right: assessing the demand, identifying the right technology solutions, quantifying the willingness to pay and gaining the trust of communities.

Dipal Barua, Founder and Chairman of Bright Green Energy Foundation, recalled the early days of market development in Bangladesh and said: “We never thought about the business model, we just focused on addressing our difficulties in the early days. But gradually, it became a business, and today it is a USD 1 billion market in Bangladesh. We knew that for solar to work, we needed it to be technologically viable, financially viable and socially acceptable. And if this happens, people will accept it and markets will scale.” As such, Bangladesh’s market for off-grid renewable energy products is segmented by economic group

and services desired (e.g., lighting, mobile charging, small fan, television, etc.). This process of market assessment and development did not happen overnight, however. Bangladesh today deploys over 1 million solar home systems a year, but the first ten years saw just 10 000 systems installed. When the Grameen Shakti initiative started in 1996, there was very little awareness and knowledge about solar energy.

Creating awareness among rural communities

The process of market development involves a great deal of convincing and persistence. Paul Needham from Simpa Networks phrased the barrier aptly: “In the villages, there are people who have experience with solar and people who don’t, and both of them don’t trust solar.” Recalling Grameen Shakti’s experience of introducing the technology to local communities, Barua highlighted: “We tried to convince [the communities] that the solar panels would use the sunlight to bring light at night – mobile phones only came in gradually 2-3 years later. We targeted the council members, or the local leaders, or school teachers, so that they would understand and spread awareness using word-of-mouth. We sent out the staff multiple times to convince a single customer. They never believed whether it would work or not, and the cost was very high.” Demonstrations go a

long way. As soon as the lights come on after sunset, there is a new wave of enthusiasm for off-grid solar solutions among communities.

“Demonstrations go a long way. As soon as the lights come on after sunset, there is a new wave of enthusiasm for off-grid solar solutions among communities.”

In areas where stand-alone solar solutions were deployed previously, many communities had a bad experience with their reliability. A fundamental reason behind this lack of trust is that government programmes and NGOs often installed off-grid lighting systems but failed to maintain them. The broken systems remain dysfunctional, setting a benchmark for how these communities perceive the technology and eventually requiring substantial resources to recover lost trust. Needham categorically highlighted: *“Stop giving away things. If you’re going to give away things, make sure you also give away the service for them to make sure they are well maintained, because a lot of damage has been done by giving away systems that don’t get maintained.”* Civil society, international development agencies and governments have an important role in ensuring this. The International Finance Corporation’s Lighting Africa initiative, for instance, focuses on quality certification and awareness building, which contribute greatly to market development.

Putting in place the financing mechanisms

Once convinced of the benefits, communities then ask: how do we pay for it? Despite dramatic cost reductions in many stand-alone renewable energy systems, their capital-to-operational cost ratio remains relatively high compared to conventional systems, and direct cash sales are not an option for the majority of unelectrified households. Recalling the early days of market development in Bangladesh, Dipal Barua highlighted: *“The cost of solar solutions was prohibitively high at over USD 400 compared to Bangladesh’s then per capita income of USD 250. On the other hand, kerosene was highly subsidised at a few cents for a litre. The financing [for solar] was initially set at a USD 200 down payment and USD 200 to be paid back in six months. It was very expensive for most households, and Grameen Shakti had limited money for giving long-term loans.”*

One of key challenges for scaling up stand-alone solutions is the availability of end-user financing for households and rural enterprises. In East Africa, where mobile banking is commonplace, off-grid projects tend to be more sustainable because people have the mechanisms to pay for energy services. A serious shortcoming of a completely grant-based approach directed at consumers is that it lacks long-term sustainability.

As such, IDCOL in Bangladesh insisted that the grant be given to the institution rather than the customer. Here, the grant forms a revolving fund that can be used to provide affordable and long-term financing to households. The Bangladesh government created a low-cost fund financed by development agencies such as the World Bank, the U.S. Agency for International Development, ADB, Japan International Cooperation Agency, KfW, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ). The low-cost fund was used to finance IDCOL, at a rate of 1-3%, which in turn lent to companies, energy NGOs or financing organisations at a rate of 6-8% depending on the loan size. Fundamentally, the institutions delivering the technology to the communities are also the ones extending the financing.

India adopts a slightly varied approach, but with remarkably different outcomes. Its policy is generally to promote the market by channelling finance to the banks, so that the banks can lend to consumers to buy the products. At the conference, it was highlighted that India’s programme has not sufficiently scaled up and that not many are taking the loans. This may be due in part to implementation problems, but at the core is the assumption that the energy poor are willing to go into debt to purchase a new technology that they’ve never tried or have likely had a negative experience with. Recalling one such experience, Paul Needham stated: *“I met one customer who said that he knew he could get a loan from this bank to purchase such a system, but what if the system breaks? What if 1-2 years from now, the company who sold it to me is no longer here? He has seen that happen. Then, he goes back to kerosene, but still owes the bank, so he is paying twice.”*

The financing institutions echo the same challenge, noting that it is very risky to lend people money to buy a solar home system because it needs to be maintained. As a lender, how do you know that the company selling and installing the system is going to

stay around and maintain that system? Essentially, once such companies are paid, the incentive to ensure sustainable operations of systems is limited.

Bangladesh is an example where capital enters the system in a different way. Consumers are not asked to go into debt from a bank to purchase from the company that is selling or installing the system. They are financed directly by the company, through so-called point-of-sale financing. Since the vendor is financing its own customers, it is forced to think about whom it is selling to in terms of assessing credit risk. From the consumer perspective, this approach eliminates the technology risk: if the system doesn't work, the consumer doesn't have to pay. As Needham put it: *"It's part of our sales pitch. We say if it doesn't work, you don't pay. We promise it will work, but you don't have to believe us. Just trust us that you don't have to pay if it doesn't work."*

Peter Ballinger, Director of the U.S.-African Clean Energy Development and Finance Center (OPIC), agreed: *"Point-of-sale financing is key, and it's where OPIC and other development finance organisations can step in."* This approach puts the onus on those who borrow from a development finance organisation, which is desirable because they understand the market. As such, the point-of-sale model cannot be a blanket model. As Bairiganjan from Arc Finance highlighted: *"Some of the smaller solar lantern companies at this point would not have the bandwidth to go out and do the collection the way other companies following the point-of-sale financing approach do. The kind of customer we are talking about, especially in a market like India, is very diverse. So we should be looking at various models until we can say which model works better for a solar lantern company."*

Another question that arose regarding point-of-sale financing was whether it is a conflict of interest for the same company to both assess a customer's ability to pay for a system, and also sell the system to the customer. One could argue that working with a financial institution enables a check on the servicing company: if the company doesn't service the system, it does not receive a loan again. SELCO in India relies on strong relationships with local banks to help customers get loans from the banks to purchase the products. The bank managers trust that SELCO will maintain the product. At the same time, work has been done in the community to build that trust, so customers feel assured that SELCO will be there to service the system. Such investments in relationship building are not always possible for a new market entrant, however.

Needham with Simpa Networks highlighted: *"We didn't have the time to build that trust through experience. So our approach to winning over the customers' trust is to finance our own products. We believe this is a more effective way for a new market entrant to win over that trust quickly in the market and to scale up."* On the issue of potential conflict of interest, there appears to be a strong incentive to build, design, deliver and service high-quality systems. Needham added: *"If I'm going to own 15 000 systems this year (2014) and 50 000 next year (2015), as our goals are, those better be very high-quality systems that require very low maintenance."*

There can, however, be a conflict of interest on the front line, where a sales person is compelled to make a sale and his commission is based on how many new customers he signs up – which is not the same thing as how many customers continue to pay. Where the organisation manages its own sales, commissions are structured in a manner where a portion of their commission comes from the upfront sale, and a larger portion of their commission comes from the ongoing payments from the customer. In this way, conflicts of interest can be eliminated through appropriate incentives and structures for the front-line salespeople.

Another dimension of financing altogether focuses on energy enterprises, not end-user financing. Eventually ensuring a scale-up in electricity access will require the participation of a broad variety of local energy enterprises. Creating the right ecosystem for their growth was high on the panel discussion agenda.

Supporting energy access enterprises

When developing an enterprise, there is a stage prior to scaling-up that occurs before the enterprise receives the necessary limelight to secure financing. The challenge is for a start-up to sustain itself until it is able to showcase itself on appropriate platforms. Because of the lack of a support ecosystem, many promising companies fall through the gaps. Even once enterprises have proven business models and are able to secure funding from mainstream sources, they face the challenge of raising working capital. As Srey Bairiganjan highlighted: *"There are really no debt funds in India at this point that support enterprises at this [scale-up] stage. What happens because of this is, once again, thousands of entities fall through the gaps."* One solution is to continually engage with financial institutions to

mobilise small amounts of debt. There is also a need to sensitise banking institutions and to provide dedicated capacity focused on financing energy access (e.g., commercial banks with a specific energy division).

Developing the skills to support the sector

Training people to install, operate and maintain systems is critical to ensure the scalability and sustainability of off-grid projects. A key challenge in the early days of Bangladesh’s market development was recruiting and training technicians. On the one hand, trained engineers did not want to work in off-grid areas if alternative opportunities existed. At the same time, not enough technical people were well versed in solar energy. Recalling the challenge, Dipal Barua said: *“So we trained ourselves, even vendors. Solar is high-tech, but once it is installed, fixing the charge controllers and batteries is not that complicated. We train people in that particular area, and once it is installed, local technicians maintain it. We need to realise that people are innovative and creative, so they can design systems in a manner befitting their local contexts.”*

Training is a continuous process – IDCOL trains 100% of its customers in maintaining a solar home system. It was highlighted that in many countries, even small problems involving wiring are often not solvable locally due to a lack of semi-skilled or skilled manpower. There is an urgent need to create this type of pool, particularly in rural areas, in order to gain trust and build a value chain.







Operational challenges: payment collection and establishing buyback systems

As programmes and enterprises scale and as the number of households serviced expands, repayment becomes challenging. The process involves collecting significant amounts of cash. Often, because of the manual nature of the activity, there are cases of people siphoning off money. Therefore, electronic systems that enable customers to pay through mobile banking or another mechanism can be relevant.

Establishing a buyback mechanism for the systems helps boost confidence among consumers. Off-grid solar systems are often guaranteed for 20 years, but after a few years the households may want to sell it back. This could happen because the grid may arrive in the village, making the off-grid system undesirable, or the customer needs a bigger system. The buyback contract brings confidence as there is an option to return the system, or even sell it.

Thinking beyond markets alone

It was highlighted that an integral element of market development is developing the community’s capacity to participate in the market. This is where civil society comes in. Roderick De Castro, Executive Director of TEAM Energy Foundation Inc., highlighted: *“Energy access programs are not just about market development or economic development. It is also about social development, and value creation plays a major role. It is something soft that may not be considered enough by financiers, but it is very important when you are dealing with the ultimate consumer, which is the community.”*

MODERATOR	PANELISTS				
 <p>Akanksha Chaurey CEO, IT Power India</p>	 <p>Peter Ballinger, Director, U.S.-African Clean Energy Development and Finance Center, OPIC</p>	 <p>Dipal C. Barua Managing Director, Bright Green Energy Foundation, Bangladesh</p>	 <p>Paul Needham President and Co-founder, Simpa Networks, India</p>	 <p>Roderick De Castro Executive Director, TeaM Energy Foundation Inc., Philippines</p>	 <p>Srey Bairiganjan Project Manager, Arc Finance</p>

Session 3

Socio-economic impact of off-grid renewable energy deployment: meeting basic and productive needs

KEY ACTION POINTS

- » Access to modern energy through off-grid renewable energy solutions present tremendous opportunities across the health, education, agriculture and water sectors. National rural development strategies need to adequately recognise these opportunities and synergies.
- » Maximising socio-economic benefits requires clear and strategic planning, and coordination among different public institutions. Such efforts benefit from an integrated approach rather than one based on specific projects.
- » Capacity building and community engagement are critical to the sustainability of the off-grid sector, and measures to facilitate skills development, local job creation and community awareness contribute greatly to sector development.
- » The definition of energy access deserves special attention to include both qualitative and quantitative indicators. Assessing both energy services offered (supply) and consumption helps better guide efforts to provide energy that is adequate, reliable and affordable.
- » Technology adaptation needs to be supported to enable productive uses in electrified communities. This means ensuring that a variety of appliances are available in the market that are compatible with off-grid electricity solutions.

Access to modern energy is a socio-economic development imperative. It can stimulate economic activities in rural areas, support entrepreneurship, enhance security and improve general well-being. The objective of universal electricity access is not merely a question of making available a certain number of kilowatt-hours, but an opportunity to stimulate a more systemic transformation. Depending on how energy is delivered and used, the socio-economic benefits from improved access can vary.

The previous two sessions looked at energy access discussions from a policy, regulatory, business and financing point of view. The third session adopted a socio-economic perspective to better understand issues related to the interface between energy, communities and their energy aspirations. The session moderator, Robert F. Ichord, Jr. from the U.S. Department of State, initiated the discussions by outlining the breadth of the issue at hand: “The benefits that come from introducing energy services

in rural areas cut across different sectors, whether it relates to water, health, education, security, environmental issues or gender. Looking at the benefits of these impacts, we need to look at different levels. We need to look at the national policy level, the community level, the individual level, the household level.”

The session focused specifically on the socio-economic benefits of expanding energy access through off-grid renewable energy. Iskandar Kuntoadji, co-founder of IBEKA, a community micro-hydro enterprise from Indonesia, said: “Energy is an entry point for social transformation from poverty to well-being. Poverty is only a symptom. The real problem is connection between the community and the local resource. Renewable energy is a powerful tool to reconnect the community with local resources. But to do this, we need a paradigm shift from centralised power generation to decentralised power generation.”

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The distributed nature of off-grid renewable energy systems means that much of the deployment value chain can be localised, requiring inputs from rural communities themselves. This enhances the sustainability of energy access efforts and also brings value to rural economies through employment, skills development and eventually through productive uses enabled by electricity access. But the first step of analysing the value added from energy access is looking at how it is defined, since socio-economic benefits depend on the type of access being provided.

The need to define energy access in a comprehensive manner

Discussion surrounding the definition of energy access has been ongoing for decades. There is no globally accepted definition of what constitutes access, with different classifications being adopted by international programmes, such as the multi-tier framework laid out by the Global Tracking Framework, or by national governments. The call for a more comprehensive approach to defining energy access that includes both quantitative and qualitative measures has grown stronger.

Aaron Leopold from Practical Action presented the “Total Energy Access” concept, which focuses on defining access in terms of the energy services that can be provided to communities and households (as an alternative to static indicators such as grid connection), with a particular focus on productive uses. Although solar home systems can provide basic lighting and can power a mobile charger, low-voltage television or radio for entertainment purposes, they usually cannot power a motor or a sewing machine that can help generate income. Stand-alone systems are a dire necessity in many countries to meet basic needs, but they cannot be the starting and end point of energy access efforts.

This understanding needs to be reflected in the broader ecosystem to support energy access efforts. Financing institutions, for instance, need

to consider (and promote) projects that are able to provide meaningful access, and that therefore can unleash the broad range of potential socio-economic benefits from rural electrification. It is also important to adequately consider the growing energy aspirations of rural communities. Access to lighting is quickly followed by aspirations for mobile-phone charging, refrigerators and televisions. Experience suggests that growth in demand is rapid, and any initiative, whether private or public, needs to accommodate the rising demand for kilowatt-hours. At a local level, however, energy aspirations are not limited to households alone and expand into a multitude of sectors, such as health and education, each with its own development agenda.

Engaging stakeholders beyond the energy sector: building the ecosystem for maximising benefits

Modern energy offers the possibility for bringing new socio-economic opportunities across sectors. Today, some 1.3 billion people are without electricity access, while some 800 million are without access to clean water, 1 billion are served by unelectrified health facilities, and more than half of all children attend schools without electricity. All these together pose a development challenge with energy at the core. Off-grid renewable energy technologies represent a collective solution to address these challenges, creating a very compelling case for thinking about energy access in a more holistic manner.

The key question is how to adopt a nexus approach, not just in community-scale business models, but more importantly in national policy making. A crucial way is to break down the communication barriers between institutions themselves and to promote co-ordination. In existing government structures, separate ministries typically look after energy matters, health, women’s empowerment, and skills and entrepreneurship. Promoting interaction among these different stakeholders can help formulate solutions that look at the entire ecosystem.

Energy access discussions often attract the same audiences and fail to engage other stakeholders such as anchor customers, health services providers, educators and water professionals. Unless all of these stakeholders are engaged within a collaborative framework, energy access efforts will have limited effectiveness and impact on the socio-economic development of rural communities. In this connection, Soma Dutta, with the ENERGIA International

Network on Gender and Sustainable Energy, highlighted that when the energy community says that 4.3 million people are suffering from indoor air pollution issues, this doesn't have the same impact as when, for instance, the World Health Organization (WHO) says it. This then leads to a situation where the WHO becomes the biggest advocate for the clean cooking movement – making it a public health issue and thus attracting more attention and financing and raising the profile of the issue overall.

Supporting the importance of such engagement, Laurie Navarro, President of CleanEnergy Solutions International, recalled her experience when leading the Philippines' AMORE programme: *"While it was a rural electrification programme meant to provide access to lighting in off-grid communities, we learned from the community consultations that, more than lighting, households would prefer access to clean water. Others would prefer means by which their children would get access to better-quality education."* It is clear that there is an affinity for particular renewable energy technologies for specific sectors in off-grid communities. But the big challenge remains sustainability.

Sustainability is central to reaping socio-economic benefits from improved access

For communities to reap the benefits from improved energy access, the energy supply needs to be reliable and the system needs to be financially sustainable in the long term. A key challenge with entirely subsidised programmes is that this often leaves minimal resources for maintenance and the replacement of components. What helps is having opportunities for a constant source of income generation, such as from anchor loads.

Navarro cited a project that deployed solar PV systems to provide access to clean water. The costs were highly subsidised, thus challenging the sustainability of projects. What worked in the project's favour is that the chosen community had nearby resorts (which could be considered anchor loads), so that, in addition to selling potable water to households, the project was able to earn income by catering to the demands of nearby commercial establishments. Tapping into these sustainability-enhancing opportunities requires substantial planning. Navarro added: *"We know that there are socio-economic benefits to be gained in the off-grid deployment of renewable energy, but there should be clear and strategic planning on how such benefits should be*

maximised. It's not something where you implement phase one, and think about what phase two will look like. It has to be an integrated approach."

"We know that there are socio-economic benefits to be gained in the off-grid deployment of renewable energy, but there should be clear and strategic planning on how such benefits should be maximised. It's not something where you implement phase one, and think about what phase two will look like. It has to be an integrated approach."

Additional focus needs to be placed on community engagement, particularly with the deployment of off-grid renewable energy. Community organisation and capacity building are critical for the acceptance, support and ultimately sustainability of the systems. In the past, many projects failed because of what can be called the touch-and-go approach, whereby institutions go into an area, put up the systems they like, and then leave the systems.

Focusing on community engagement and capacity building

Most of the unelectrified rural communities are indigenous and are on the receiving end of a top-down development approach. Expanding electricity access can transform lives in these villages. The challenge is to ensure that the deployment of off-grid solutions is not unthreading a community's ties to sustainable ways of living. It is important to identify ways that modern energy services can be expanded while nurturing, not destroying, the indigenous culture.

Iskandar Kuntoadji highlighted the approach that he adopts in Indonesia: *"What I do first is send a person to live with the community. They go through three phases. The first phase is recognising, the second phase is consolidation and the third phase is organisational reinforcement. After these three phases are completed, then they will enter the fourth phase of self-reliance. Only after that, we can do our construction work. If we don't go through these phases, then sustainability is missing and the local culture cannot be preserved."* Through this approach, the community is prepared for and made aware of modern energy over a period of time. Kuntoadji added: *"In 60 areas where I have built micro-hydro, all of them*

paid the tariff higher than our utility. In the case of the first micro-hydro I built in 1999, the community paid USD 0.08 per kilowatt-hour when the national utility tariff was only USD 0.024 per kilowatt-hour, because they had the willingness and awareness.”

Although important, working with local communities can be tricky. It varies greatly among countries because of cultural and socio-economic issues, and it is important to assess who conducts the community engagement. Several companies have tried to go into villages and have highlighted that they completely underestimated the effort it takes to develop a supportive environment at the community level. Existing networks of NGOs in many countries are active in rural communities, and the challenge is for these different stakeholders to co-ordinate and work together to develop a supportive environment for energy access efforts.

Divyam Nagpal from IRENA highlighted that: *“There is a lot of emphasis on engaging local capacities, building local capacities, involving local communities at different stages of project development. In part that is because the objective is to stimulate socio-economic development, but also because it helps improve the sustainability of business models. By localising parts of the deployment value chain and building the necessary skills locally, system lifetimes and reliability of supply can be enhanced.”*

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In fact, many of the 4.5 million jobs (estimated by IRENA in its *Renewable Energy and Jobs report*) that could be created in the off-grid electricity sector by 2030 can be local jobs, allowing value and skills to be retained within the local communities.

A substantial focus on capacity building – education, vocational training, etc. – will be required in order to achieve the target of universal energy access by 2030. In the West Africa region alone, the Economic Community of West African States (ECOWAS) estimates that 120 000 mini-grids will need to be deployed to achieve universal electricity access. Aaron Leopold highlighted: *“I would venture to guess that*

there are less than 200 firms that are actively working in the mini-grid space today. Probably less than 150. When you put those two numbers together, there’s a very pessimistic outlook.”

Growing awareness is needed on what measures are necessary to allow off-grid solutions to scale up. A critical factor will be ensuring the supply of technical and managerial skills to support a growing sector. This will require integrating education on off-grid and small-scale energy systems into technical curricula at universities. At the lower level, frameworks need to be in place for increasing awareness among people on how energy can benefit them. This requires policies and regulations, and governments at both the national and local level will play a crucial role in this regard.

Role of governments and other stakeholders

The role of the government differs depending on the stages of market development. Based on SNV Netherlands Development Organisation’s (SNV) experience with developing a market for biogas in Vietnam, Dagmar Zwebe, Sector Leader on Renewable Energy – Vietnam, highlighted: *“In many countries before we [SNV] entered, such as in Vietnam, there was no market for domestic biogas. There was no supply and no demand, so on both sides it was a problem. The partnership with the local government was extremely important to create awareness out there and to reach people in all regions of the country. At the same time, there was a lot of focus on the development of supply and the development of enterprises.”*

Market development efforts included executing quality control, training activities, or other relevant activities. In Vietnam, over 1 400 leaders of micro-enterprises supplying domestic biogas were trained. But there are downsides of such co-operation. Zwebe highlighted: *“While the government is needed in an early stage, the downside is that it’s hard to say goodbye to a good partner. And when the market is ready, you do need to say goodbye, and you do need to transfer some of the responsibilities that are now in the government to the market and give the market the chance to operate on its own.”* The biogas market in Vietnam will be ready to operate independently by 2017. Nearly half of constructed biogas is now taking place outside of donor-funded programmes, a clear sign that the market is ready for independent operation.

Governments need to see access to energy as a window for further development. It is also important that the process of development not be left only to governments or to the energy companies alone and must involve all the players, including NGOs. In the process of expanding energy access, people are being empowered and rural economies are being strengthened. This is an important contribution to the mandate of local governments. Energy companies have commercial interests in providing energy services, and NGOs want to empower people and bring about socio-economic benefits by using energy as a development driver. However, this may not always follow the same approaches of local governments. Aaron Leopold drew on Practical Action's experience in installing a micro-hydro plant in Malawi, where local politicians opposed the plant because the price would be higher than the subsidised grid price.

Governments also need to be transparent about the time frames associated with grid expansion – a crucial barrier to getting community support for off-grid solutions. Grid extension plans may undergo unplanned changes from time to time, and even where grids are extended, there frequently is no or unreliable supply. In some cases, the grid does not extend all the way to the community. Even when it does, communities often pay for the last bit of the line. In some countries, grid access is defined as when a household is within six kilometres of the nearest sub-station. The community is expected to pay for the actual extension line to that sub-station, but it is already counted as having access because it is within the six kilometre range. On the role of NGOs, Soma Dutta drew on her experience managing a programme based in Sri Lanka, Bhutan and Nepal. NGOs and civil society organisations in the three countries provide the last-mile support to the utility. They operate in areas where electricity is coming in (primarily grid electricity) or expected to come in soon, to provide support in awareness creation, in telling people how to use electricity (and use it more productively) and in conservation and safety issues. This approach works well because it creates an appetite for electricity. It also helps the utility, which does not have the infrastructure and outreach to spend that much time locally. This type of painstaking exercise, however, takes considerable resources and effort. Although it does improve the effectiveness of the service, there is a cost attached to it, which is something to keep in mind.

Looking at productive uses

Emphasis on productive uses is often seen as a way to ensure socio-economic development of rural communities through energy access. However, questions remain within the development community regarding what constitutes productive uses and what kinds of approaches are necessary to ensure that the electricity provided, or the fuel from biogas, etc., can have maximum economic impact and create income-generating activities at the village level. There is a need to consider productive uses more broadly, to also include non-economic uses.

"There cannot be productive use without first meeting basic needs."

Dutta argued that there cannot be productive use without first meeting basic needs. In most rural areas, considerable time is spent on basic subsistence tasks, and engaging in productive uses with modern energy requires freeing time from these tasks. Laurie Navarro highlighted the need to recognise the inherent limitations of specific technologies. For example, solar PV systems for household lighting do not offer many more applications for the power generated from a 20 Watt-peak system. In off-grid communities where there is potential for micro-hydro, socio-economic benefits are possible, but basic needs should be met first before meeting economic activities. Navarro added: *"In one of the communities we have electrified through a micro-hydro project, after providing electricity to some 80 households, they started tapping the mechanical power for corn milling, and still there was excess electricity. So they put up a battery charging station for the farthest households that cannot be tied to the grid. All of these activities came in naturally, but only after meeting the basic needs."*

Navarro also highlighted that to maximise the socio-economic benefits of renewable energy deployment in off-grid communities, electricity should be used for existing, rather than new, industries. She noted: *"From our experience, it has been extremely difficult to use the power generated to start a business that produces new products for which the whole marketing network will have to be established. That in itself is a separate project."*

Sandeep Giri from Gham Power added to the discussion from the audience by providing a

developer's perspective on productive uses: *"This whole issue of whether energy should come first for basic or productive use, I'm not even sure why this is a question. I don't think one arises without the other ... We're out there developing projects, and for those projects we need financing. We're looking for investors, and those investors won't invest unless there is a return. So, I will look for productive use, that's how I get investors excited."* Moreover, he said that because existing profiles of off-grid projects do not offer the type of returns that traditional investors are looking for, development agencies, such as ADB, need to be engaged. This is when the issues of basic needs, gender, education and health all become increasingly relevant. Giri added: *"That forces me to become a true social entrepreneur, where I have to look at both basic use and productive use, and my challenge is to find the right balance and the right type of projects."*

Bringing the gender perspective into energy access discussions

There is a need to recognise the role of women within a core strategy on energy access and in off-grid renewable energy deployment. A key reason is that 70% of the world's poor people are women. So in terms of development effectiveness, if energy services are to be equitable, then they must reach women and men equally. Moreover, women – through their networks and through their families and neighbours and associates – are really able to reach the last mile. Finally, there is growing evidence that when women earn an income, it has a multiplier effect, much more than men. Women tend to spend more on their families and on educating their children, so the impact goes much farther than just the immediate income earner.

Traditionally, the discourse on gender issues in the context of energy access has focused on women carrying fuelwood, impacts of indoor pollution, health aspects and so on. Typically, all of these treat women as victims. Another aspect to the discussion, however, is much less recognised. A large number of women are slowly but very steadily becoming an integral part of the energy access solution – selling energy services, maintaining systems and securing financing at a fairly large scale. This shift can no longer be considered just anecdotal. Examples include SELCO in India, Grameen Shakti in Bangladesh, the

cookstoves programs in Cambodia, the cookstoves and hydro programs in Nepal and Solar Sisters in Africa, all of which demonstrate the significance of women in delivering energy access. All of these interventions are large scale: involving 2 million cookstoves in Cambodia, at least 300 000-400 000 cookstoves in Nepal and biogas stoves that are disseminated largely through women.

The way forward

The role of off-grid renewable energy systems in providing critical elements of growth, both human and economic, are clear. Looking more closely at the design of systems and programmes for rural areas, it is important to understand the needs of the local population and all income strata. Scepticism remains among policy makers about the costs and benefits. What is necessary is a broader calculus of the costs and benefits that can provide a clear picture of both the tangible and intangible benefits that modern energy access can bring to rural communities.

"What is necessary is a broader calculus of the costs and benefits that can provide a clear picture of both the tangible and intangible benefits that modern energy access can bring to rural communities."

Energy companies, NGOs, governments and other stakeholders need to be able to tell a compelling story about what the impacts of these technologies are. These efforts need to be complemented by initiatives to gather and disseminate better data, which can be vital for guiding the global, national and local discourse on energy access efforts.

A lot of work remains to be done, even though studies over the years have shown how important electrification is for social and economic development. Clearly, people value the electricity. They are willing to pay if they have reliable services, and in many countries they are paying extraordinarily high shares of their income for diesel, kerosene and other energy sources. The issue of the broader socio-economic impacts of off-grid systems is equally important to the issue of how to develop the most cost-effective business and technology models.

MODERATOR

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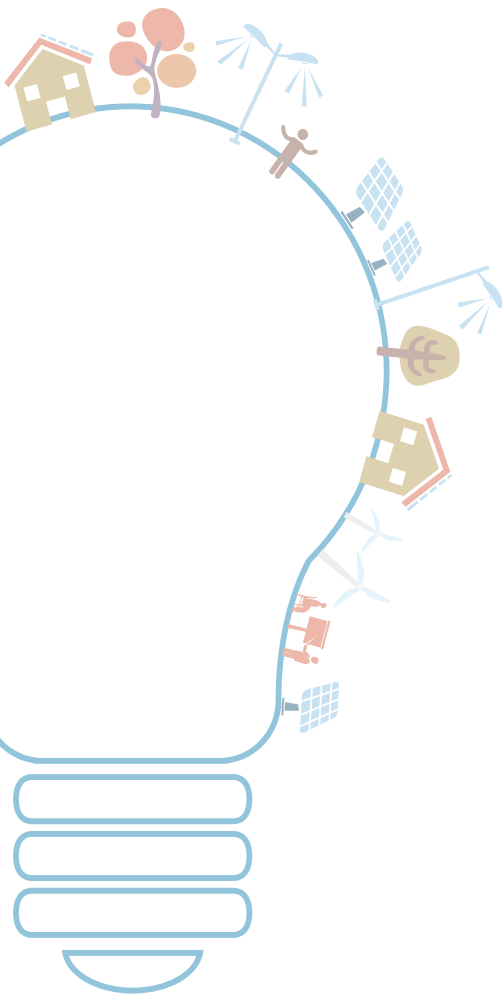
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Session 4

Developing markets for renewable energy-based mini-grids: insights into policy and regulatory aspects

KEY ACTION POINTS

- » The role of renewable energy-based mini-grids needs to be recognised in expanding electricity access to rural areas. Tremendous opportunities also exist for hybridising existing diesel mini-grids and reducing costs.
- » To facilitate participation of the private sector in mini-grid deployment, governments need to establish at least the following: a legal framework to allow participation, tariff structures that are cost reflective, support for developers in identifying villages not expected to be served by the national grid in the short to medium term, and a regulatory framework to support integration of mini-grids with main grids.
- » Renewable energy-based mini-grids have varying business, financing and technology characteristics. Policies and regulations need to adequately consider these differences and be designed to support context-specific mini-grid development.
- » There is no one-size-fits-all solution to tariff setting, and a balance needs to be struck between establishing a transparent framework for calculating tariffs and maintaining adequate flexibility to account for differing rural contexts.
- » Regulatory frameworks need to provide certainty on the implications for mini-grids when the national grid arrives. Several approaches for integration exist, but it is vital to ensure that business risks for the private sector are reduced while safety and the quality of supply is maintained.

The first three sessions of the conference focused on the role of stand-alone renewable energy solutions and different models for their deployment. A collective message is that stand-alone solutions, albeit an important component of the energy access efforts, cannot be the end point of rural electrification strategies. Mini-grid solutions will need to be scaled up to cater to the growing electricity needs of rural communities and to stimulate the desired socio-economic development.

The mini-grid space has increasingly attracted significant attention – and rightly so. The IEA estimates that mini-grids will provide 40% of the incremental generation necessary to meet universal electricity access by 2030. Deploying mini-grids to expand electricity access is not a recent phenomenon, with diesel-based isolated grids being widely adopted. Owing to technology cost reductions and the rise in diesel prices, renewable energy-based solutions are increasingly a cost-effective solution for mini-grids in rural areas.

The session moderator, Gauri Singh, Director of the Country Support and Partnership Division at IRENA, noted that over the last 3 to 4 years, several entrepreneurs have moved on the ground and established themselves as mini-grid developers, with appropriate business models and technology. There is general recognition, however, that existing ecosystems cannot adequately support the substantial scale-up in deployment that is necessary. Policy and regulatory frameworks are central to those ecosystems, and hence this session aimed to identify measures that governments can take to accelerate mini-grid deployment.

Identifying the key determinants of an enabling policy and regulatory environment for mini-grids

The session discussions provided insights into how exactly mini-grid deployment is affected by policy and regulatory frameworks. An understanding of these impacts, particularly from a developer's

perspective, provides the first indication of measures that may be necessary to scale up further deployment.

First and foremost is a recognition of the role of renewable energy-based mini-grids within the electricity sector. Mini-grids have a great potential to meet demand in rural areas, but currently most countries continue to follow a very conventional idea of rural electrification, based mainly on grid extension.

“Mini-grids have a great potential to meet demand in rural areas, but currently most countries continue to follow a very conventional idea of rural electrification, based mainly on grid extension.”

There is a need to raise awareness of the potential for mini-grids. China, for example, pursued the development of small hydropower plants in early 1950s, where the plants first operated in standalone mode and were then connected to the national grid as it expanded to rural areas. On the backing of substantial development of small hydro-based mini-grids and expansion of the national grid, China's electricity access rate has increased from 40% in the early 1980s to 99.7% by the end of 2011. In Nepal, of the 74% of households with electricity access, 14% are serviced by off-grid solutions, mainly micro, mini and small hydro projects.

Recognising the potential of renewable energy in mini-grid applications is essential. Growth in decentralised renewable generation is compelling some governments to restructure power markets and rethink energy infrastructure. By embracing distributed generation, developing countries have an opportunity to leapfrog the learning curve and to do it “right” from the start by supporting distributed generation and distribution systems, with the possibility of attracting participation of independent power producers (IPPs) and micro-utilities in enhancing outreach of energy services.

It should be noted that where mini-grids do form part of electrification strategies, the focus is still often on diesel-based systems. As the session moderator Singh noted: *“A number of rural electrification plans in countries don't even mention the possibility of renewable energy for powering mini-grids. If one looks at the rural electrification policies in a lot of*

countries, they only talk of more and more diesel-based mini-grids that need to serve the communities not served as of yet.” Increasingly, however, many countries, such as Mali, the Philippines, Senegal and Tanzania, are setting up policy frameworks that allow for large-scale deployment of renewable energy-based mini-grids.

Another vital measure to support the sector is putting in place the right conditions to allow participation of the private sector. Discussions highlighted that the main elements of such conditions include: 1) allowing participation of private developers in the mini-grid sector, 2) permitting developers to charge cost-covering tariffs, 3) providing the information necessary to identify and select villages for mini-grid projects and 4) establishing regulatory frameworks to allow integration with grids, if necessary.

Policy frameworks to enable participation of private developers in the mini-grid sector

The first step in allowing private sector participation in the sector is to establish the policy and legal frameworks that govern this involvement. Such frameworks must consider the broad range of mini-grids being deployed, which can differ in the renewable resource utilised, the services provided and the ownership/financing structures adopted. The challenge for policy makers is to devise policies that cut across these differences and to provide a support framework that addresses the specific deployment and operational challenges that developers face.

Experience from countries discussed at IOREC shows the diverse policy approaches being adopted. Senegal, for example, uses a concessionary approach to enable the participation of micro-utilities in the sector. There is a defined tariff scheme, with several mini-grids already in the pipeline. Nepal follows a slightly different approach, wherein the policy defines the subsidy, loan and equity ratio (40:40:20) for owners of a small hydro project – community or individual entrepreneurs. The tariff is negotiated between the end-users and developers. The regulations governing the licences state that projects under 100 kW do not require a licence, but need approvals from a small Water Resources Committee within the local government to deal with water rights issues at the local level. In recent years, due to the acute shortage of power, solar PV installation in grid-connected areas has been rising, and there is pressure on the government to extend the subsidy scheme to these systems as well.

In India, existing regulations allow a broad range of energy service companies to operate without licences. The lighting company Mera Gao Power, for instance, has a customer base of just over 20 000 households and does not require a licence to operate, as the relevant electricity act in India exempts a person intending to generate and distribute electricity in a rural area from obtaining any licence from a regulator, while conforming to the provisions relating to safety and electricity supply.

The level of regulation that is appropriate for the mini-grid sector has been a subject of intense discussions. Often, developers state that over-regulation (or any regulation for that matter) can hamper a business model, since it leads to additional costs. The counter-argument, as highlighted by Rana Adib from the REN21 Secretariat, has been that regulations are necessary to plan for certain critical moments: for instance, when the grid arrives, what happens to the assets, or if there is a possibility of connecting the mini-grid to the main grid. These uncertainties are impeding a private sector-led scale-up of the sector. From a regulatory point of view, the critical issue of tariffs directly affects the business case for mini-grid deployment and the long-term sustainability of a project.

“From a regulatory point of view, the critical issue of tariffs directly affects the business case for mini-grid deployment and the long-term sustainability of a project.”

Understanding mini-grid economics and setting cost-recovering tariffs

Looking at the cost structures of mini-grid companies shows that tariffs should reflect cost structures in order to ensure sustainability. Most of the costs of a mini-grid company are fixed costs: project development, asset depreciation, interest on debt, etc. At IOREC, it was highlighted that what is not always obvious is that most operational costs are also fixed costs, of which the head management cost is a big portion. The smaller the mini-grid gets, the smaller the company gets, and the higher the head management costs are as a percentage of total costs. Other operational costs, such as local management, customer relationship management and money collection, are all fixed costs. Whether one collects USD 1 per household per month, or USD 500 per

household per month, the collection costs do not change significantly in many cases. There are some limited variable costs, such as maintenance and fuel. Tariffs should reflect these mini-grid economic structures. Having a fixed income proportional to fixed costs translates into less risk for the mini-grid operator. In that case, flat-rate tariffs are often a suitable option. However, with a flat-rate tariff one does not incentivise people to use energy efficiently. Keeping these factors in mind, Nico Peterschmidt, Managing Director of INENSUS, stated that: *“So what we as entrepreneurs would like to see is encouraging regulatory agencies to think about tariffs that reflect the costs structure: with a fixed cost component and an operational component.”*

Bringing in perspectives from the tariff-setting process for India’s Mera Gao Power, the co-founder Brain Shaad highlighted that the company uses a fixed-rate tariff across all communities. The reason is two-fold. First, they realised at the very beginning of the tariff-setting process that they are limited by the household’s current expenditure on energy, which is mostly for kerosene and mobile phone charging. Second, they learned not to inject any options regarding the service provided or how it is delivered. Shaad highlighted: *“Any time we overly consulted with a village on what it is they would like, what they should pay for it, it just created drag in terms of our project development process.”*

It is also important to look at tariff structures for grid electricity. Uttar Pradesh, the state where Mera Gao Power operates, has a fixed tariff of INR 120 (-USD 2) per month for power – whether a household receives electricity or not. Other charges over and above this fixed tariff include a meter charge and service. Shaad added: *“Now we feel the best way to do it is to identify a fixed tariff across areas where incomes will be the same, and they’re getting a better deal than they currently get.”*

The principle of establishing specific tariffs for different areas was also supported by Nawaraj Dhakal from the Alternate Energy Promotion Centre in Nepal: *“Sustainable operation of projects should be the centrepiece while deciding the tariff structure, and that is what we are trying to do. But, we do not dictate the same tariff rate everywhere.”* Dhakal added that the Centre tries to advocate for at least 20% of the total income of the project to be set aside for major repair and maintenance. The remaining 80% should cover operation costs, and if operators are willing to provide certain dividends, this too should

be included in the 80%. This is being promoted as a rule of thumb, in order to help sustainability.

The moderator, Gauri Singh, cited the example of Senegal from 2011, when IRENA was conducting a Renewables Readiness Assessment. The regulations in Senegal are such that the regulatory commission is required to come in and set the tariff for any grid operator, anywhere in the country – whether it is a small mini-grid or a large power plant. Hence, mini-grid operators have had to travel to Dakar from project sites to make continuous petitions for tariffs, adding cost to the system. To avoid such additional costs, the framework for tariff setting needs to be less cumbersome, more predictable and yet adaptable to different contexts.

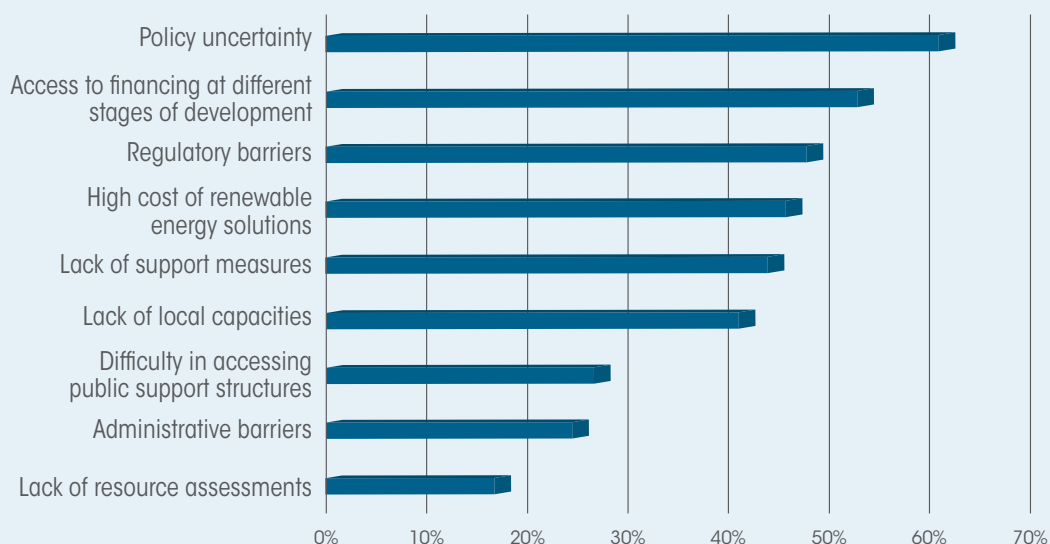
A key challenge for mini-grid tariff setting is its comparison with grid electricity. It should be taken into consideration that grid electricity is often subsidised and that it is necessary to create a level playing field for renewables-based mini-grids in order to avoid market distortions and to allow for sustainable development of the mini-grid sector through private sector involvement.

Support in identifying and selecting villages

Governments can support developers in identifying and selecting villages for mini-grid development. This time-consuming and resource-intensive stage – which involves demand mapping, market development and community engagement – is presently being conducted by private developers. Local governments are well placed to support the private sector in this task, including by helping to provide clarity on grid extension plans in the medium to long term. Nico Peterschmidt highlighted that: *“If governments support us in selecting a village – saying, well here’s a village that is pretty large that will not be connected to the grid in the foreseeable future, let’s say 5 years, 10 years, 15 years – this is a starting point for us.”*

“If governments support us in selecting a village – saying, well here’s a village that is pretty large that will not be connected to the grid in the foreseeable future, let’s say 5 years, 10 years, 15 years – this is a starting point for us.”

FIGURE 3. PRIVATE SECTOR PERSPECTIVE: WHAT ARE THE LARGEST BARRIERS THAT HAMPER THE DEVELOPMENT OF THE RENEWABLE ENERGY-BASED MINI-GRID SECTOR? (% OF TOTAL RESPONDENTS*)



*RESPONDENTS COULD CHOOSE UP TO FOUR ANSWERS

Having this support can allow developers to achieve economies of scale more rapidly in the identified villages, and can mitigate risks. This barrier, among others, was also reflected in the private sector responses to the IRENA regional stakeholder survey (see Figure 3). Private sector respondents highlighted policy uncertainty as the largest barrier to developing the renewable energy-based mini-grid sector, followed by access to financing and regulations.

Shaad shared a similar experience from India: *“We know that they [the governments] can’t get to certain areas, say within the next 5 years, 10 years, maybe 20 years in some cases. Our feeling is that we can operate much more efficiently if we knew what areas are going to be off-grid for the next five years. So the biggest help would simply be to give us some of that data. We don’t need to know the plan for the whole state – just show us what’s planned for one district.”* The moderator, Singh, agreed, highlighting: *“This is extremely important data. And as you have very correctly brought out, how do we expect entrepreneurs to come into the setting and take risks if they don’t know what they can plan for?”*

But having certainty in planning is easier said than done. Bringing in the government perspective, Nawaraj Dhakal highlighted that governments often do have grid extension plans, but they are not always followed. Political decisions are among the primary reasons for abrupt changes in grid extension plans, adding to the risk of micro- or mini-hydro projects. What happens to an existing mini-grid when the grid arrives is a key regulatory question, and deliberations are afoot to identify frameworks through which the risks can be mitigated.

Regulatory frameworks to allow integration with national grids

At IOREC, it was highlighted that several approaches can be adopted to integrate mini-grids into main grids. One approach currently in practice is the concession. In Senegal and Mali, developers can get a concession of 15 years for operation, within which all assets are completely depreciated. Should the grid arrive in that time, developers get a guarantee for compensation. In the absence of a concession, it makes a difference whether the installed mini-grid is up to the grid standards. If the regulatory agency requires mini-grid operators to install grids according to national standards for distribution grids, then the grid can simply connect to the mini-grid, technically. But how does this work financially?

Peterschmidt highlighted that one option is to split assets of the mini-grid infrastructure. The ownership stays with the national distribution company, or with a national or local authority. The mini-grid operator can then just take the moveable generation assets and install them somewhere else or sell them on a second-hand market. Usually, some compensation for additional effort would be required to keep the mini-grid operator from incurring large losses.







Another option would be to keep the mini-grids in the hands of the mini-grid operator once the main grid reaches the mini-grid. In that case, the mini-grid operator could operate as a small distribution company complementing the main grid at times of load-shedding. The problem is, the mini-grid operator cannot rely on the unavailability of the main grid. As soon as the availability of the main grid improves, the mini-grid operator will begin realising losses because it cannot utilise electricity from diesel or renewable sources, for example. In that scenario, mini-grid operators would usually dismantle and sell their assets and mainly run the mini-grid from the electricity obtained from the main grid plus a certain portion of back-up generation for periods of grid unavailability.

A third option is using the renewable energy assets to feed back to the main grid. Or, a combined option is possible where the mini-grid operator still serves customers within the mini-grid, with electricity purchased from the main grid, and feeds excess power back to the main grid. This would reduce the mini-grid operator’s risk slightly, but it still is not sufficient to really convince the operator to use much renewable power.

In the case of Nepal, once the main grid is there, the national grid operator can buy back the mini-grid projects, which then can be used elsewhere or dismantled. Often, the connection of mini-grid projects with the main grid is not a priority, and efforts are being made in some cases to make connection an obligation and to establish the required rules and regulations. It was highlighted, however, that grid operators often are hesitant to support this because it can invite technical and managerial challenges, particularly related to the variable quality of electricity produced by small systems. A successful case of interconnection of mini-grids was mentioned for Nepal, wherein six micro-hydro projects feed into a common distribution network. Li Zhiwu from the Hangzhou Regional (Asia & Pacific) Center for Small Hydropower

highlighted that in China, for the small hydro mini-grids that are connected to the grid, the operations model is independent. During the rainy season, the surplus power feeds into the national grid, and during the dry season, the deficit of power is bought from the national grid.

The challenge is that the prices during the rainy and dry season are different relative to the grid, thus impairing the local power companies. However, the framework exists for the exchange of power to ensure reliable supply to the community.

MODERATOR	PANELISTS				
 <p>Gauri Singh Director, Country Support and Partnerships, IRENA</p>	 <p>Li Zhiwu National Research Institute for Rural Electrification & Division Chief, Hangzhou Regional (Asia & Pacific), Center for Small Hydropower China</p>	 <p>Nawaraj Dhakal Assistant Director, Alternate Energy Promotion Centre Nepal</p>	 <p>Brian Shaad Co-founder, Mera Gao Power India</p>	 <p>Nico Peterschmidt Managing Director, INENSUS</p>	 <p>Rana Adib Policy Advisor, REN21 Secretariat</p>

Session 5

Developing markets for renewable energy-based mini-grids: insights into financing and business models

KEY ACTION POINTS

- » Mini-grid business models evolve as enterprises develop and adapt to changing market conditions. Financial institutions need to consider this evolution process and to account for it in investment decisions.
- » Policy and regulatory frameworks should allow for innovation in technology design, finance instruments and business models. This also facilitates participation by non-traditional players in the sector. An example is the use of telecommunication towers as anchor loads to supply electricity in surrounding areas.
- » A broad range of instruments is available to improve access to financing in the sector. Convertible structures, for instance, can often be effective mechanisms to bridge the financing gap along different stages of business development.
- » Public financing is crucial in leveraging commercial and private capital. Use of instruments such as publicly backed guarantees helps de-risk investments and encourages financiers to participate in the sector.
- » There is a need for co-operation between governments and mini-grid operators to collectively identify opportunities for cost and risk sharing.
- » Supporting income-generating activities or productive uses can improve the sustainability of mini-grids by enhancing the capacity of end-users to pay for services and reduce risks.
- » Development finance institutions, among other actors, can support capacity building for local financial institutions to build trust in the sector and lower risk perceptions.

Mini-grid development encompasses a diverse set of business and financing models. These varying approaches come with their own set of risk profiles and financing structures. Despite prominent examples of mini-grid projects, scaling up successfully has proven to be difficult. Key constraints relate specifically to flexibility and innovation when designing business models (ownership structures, payment mechanisms) and financing models (appropriating capital along different stages of business development).

Don Purka, Director of Infrastructure Finance Division 1 of ADB, highlighted the panel's objective of narrowing down the diverse parameters of mini-grid business and financing models, and of unlocking knowledge on how these systems are best designed to suit diverse markets. The mini-grid sector is not a mature market yet, and the session aimed to shed

light on the parameters that define the different aspects of the sector, and to identify field-tested approaches for overcoming financing challenges and adapting business strategies.

Diversity in business models being adopted globally

The diversity of mini-grid business models stems from the large amount of variables that determine viability. Factors determining strategies for developing projects include technology, project size, ownership structure, payment collection methods, consumer needs and policy environments. To understand the plethora of business models used to develop mini-grids, it is important to define their core: what is a business model? Sandeep Giri, CEO of Gham Power, a solar mini-grid developer in Nepal,

responded: *“I like to think of it as a business trying to solve a problem in a sustainable way. There are all these different variables, but the business model starts at solving the problem.”*

In addressing access-to-energy issues, there has been a burgeoning push towards private sector-led mini-grid projects. Giri discussed Gham Power’s approach of focusing on projects with anchor clients that serve productive loads. The enterprise aims to develop projects where there are at least 2-3 businesses in that community and power can be converted directly into revenue. *“That chain makes the project more viable,”* Giri explained. To meet investor expectations on the level of return on a project, Gham Power has expanded its product offering: *“[We] don’t just sell electricity, but sell basic services needed in that community, such as rice milling, a dairy chilling centre and telemedicine. We put an Internet connection on all our systems for remote monitoring – so how do you monetise that Internet connection?”* In jumpstarting these new businesses, Gham Power’s role often shifts into business incubation: *“Sometimes, project development looks like business development, where our staff is going to the community and sitting down with community leaders, and asking things that have nothing to do with solar. But if we don’t do that, we won’t have a solar mini-grid system, either.”*

“Sometimes, project development looks like business development, where our staff is going to the community and sitting down with community leaders, and asking things that have nothing to do with solar. But if we don’t do that, we won’t have a solar mini-grid system, either.”

While companies like Gham Power are exploring enterprise-owned and -operated mini-grids, other contexts have called for alternative business models with their own strengths and challenges. Tripta Singh, Director of the Energy Access Initiative at the United Nations Foundation, shared working examples of a community-owned mini-grid structure. In Indonesian Borneo, three NGOs with complementary roles have partnered to develop renewable energy mini-grid projects. Two international NGOs help to channel the financing for installing the mini-grids, as well as offer technical expertise and community organising skills. The third NGO, a community association, focuses on training people in the skills necessary to maintain the systems. After one year of operation,

the NGOs hand over ownership to the community. A village-level committee is then created to operate and regulate the mini-grid. The tariffs are decided by the community and are directed towards a fund used for operations and maintenance. In this structure, a challenge that the projects face is their existence outside government co-operation. Because these mini-grids are not registered with the government, the only source of funding for repairs is what the community pays in tariffs. When repair costs are too high, repairs are not made. Through collaboration, there is an opportunity for the government to help fund necessary repairs and maintenance.

Select mini-grid deployment challenges

Because mini-grids provide energy services in remote, often low-income communities, the sector faces a unique set of challenges. From the perspective of private equity firm Bamboo Finance, Anu Valli, Investment Manager, commented: *“We look at mini-grids as a business that has all the challenges of a utility, as well as a social enterprise.”* Valli reflected on the experience of a prominent rural energy enterprise in India in which Bamboo Finance invested, which has encountered differing challenges while employing and adapting its business model. The enterprise has set up 80 rural power stations in total, with 55 of the plants still operating. After a streamlined expansion to 40 systems, the enterprise in India encountered problems escalating to 80 systems. One large issue was monitoring and supervising, particularly the cash collections. *“You have to take the training costs, and you have to bear the costs of losses, thefts, even pilferage of cash by your own employees.”* These challenges exist, but innovations in technology and payment schemes have emerged, with pay-as-you-go solutions that replace manual cash collections with mobile-based payments.

Through the lens of a social enterprise, an energy provider faces the challenge of matching services to the needs of customers and addressing the lack of infrastructure. Valli explained: *“As an enterprise working in off-grid solutions, invariably the majority of its customers are low-income with a varying revenue stream. So their payment patterns might also vary and they are not consistently paying you.”* In addition, financial institutions and other support structures, such as business support and mentorship, are often lacking. As a social entrepreneur, *“you have to solve the finance and other issues yourself, which adds to the costs of your operations.”*

In this emerging space of mini-grids, business models commonly need to evolve as new insights emerge from on-the-ground experiences. Faced with the challenge of managing numerous decentralised energy assets, Valli explains that the Indian enterprise mentioned previously decided to adopt a franchise model, adapting from a utility service model to a product company. A franchise model involves selling the developed mini-grid project as a package to a rural entrepreneur. Santosh Kumar, Technical Expert at GIZ, weighed in on the adaptive nature of mini-grid enterprises: *“The business model in mini-grids is a kind of evolutionary concept. You solve problems and your business model evolves.”*

“The business model in mini-grids is a kind of evolutionary concept. You solve problems and your business model evolves.”

He further highlighted the need to recognise this growth aspect while evaluating companies: *“When you go with a fixed template to evaluate an enterprise, you are completely ignoring the evolutionary aspect for the business model. How can you assess that which is yet to evolve? Let’s have this in mind when we evaluate: I am sure of about 60-70% of this, but 30-40% will evolve. For investors, they must be ready to say ‘we invested in you, and we will be here to support how the model evolves.’”*

Improving clarity on markets and opportunities

To enable business models to overcome challenges, there needs to be a clear, conducive environment for interested stakeholders to participate in the market. Marcus Wiemann, Secretary General of ARE, noted that in this relatively new market space, many unknowns still need to be addressed before attracting higher levels of participation: *“What makes a mini-grid business model successful? In the end, a business model is successful if there are enough interested actors in the market. Before private investors can engage, a number of circumstances need to be clarified.”* Large looming questions – regarding issues such as successful investor exit strategies and co-ordinating different types of financing – still need more answers. Wiemann sees the newly launched Clean Energy Mini-Grids High Impact Opportunity (HIO),

part of the SE4ALL initiative, as a targeted platform to share lessons and solutions widely.

Major interest in the sector is palpable, and more complete information defining the different mini-grid variables can help to shepherd in greater sector involvement. Kumar described a promising, but unsuccessful, initiative in which tenders were invited for electrifying a cluster of villages using mini-grids. Ultimately, only one private sector entrepreneur bid for the contract, and the project was scrapped. Kumar observed: *“There is a need. There are technologies and business models that can do this. There are people ready to finance it. There are people ready to bid for the money. Why is it not working? Why are we still struggling to figure out the solution?”*

In response to this well-intentioned but unsuccessful project, GIZ focused its efforts on making things clearer and simpler for entrepreneurs, to booster greater participation in the sector. *“We try to take an approach where we try to understand things from our side, package it together, and then go to the entrepreneur,”* Kumar explained. With many issues more clarified, such as project sizes, the policy environment, distribution models and reliability of revenue, entrepreneurs can enter the field better informed and can dedicate valuable resources to other business efforts.

Financing models: finding the right instruments

Mini-grids have received increasing attention from financial institutions; however, both panellists and public commenters noted that mini-grids continue to suffer from inappropriate financing mechanisms to suit their project type. Kumar commented: *“The typical lending models of the traditional investments in infrastructure or large energy projects do not fit here.”*

Although mini-grids contain elements of an infrastructure project, panellists suggested that mini-grid projects may not be mature enough yet to be considered as infrastructure projects from an investment point of view. Typical lending models used for larger energy projects may not be appropriate for the sector until the risks associated with reliable cash flows from electricity sales are addressed. Anu Valli explained: *“[Infrastructure investments] are based on a long-term, steady cash flow that traditional project*

debt financing or infrastructure equity investments cover. Mini-grids are not at this maturity because the steady cash flow has to come from customers, not a single entity with which you can have a power purchase agreement for 25 years. Until a mini-grid project reaches a maturity stage where you have a customer base providing you with steady cash flows, we cannot do an infrastructure type of investment."

So what financing solutions exist to fill this financing gap? How can the sector become comfortable around risks? Or, how can innovative financing be used instead of having to rely on a typical lender approach to finance mini-grids? Valli believes that the sector needs more equity investments and grants that can take the initial risk and develop business models to a stage where the mini-grid project is ready to be an infrastructure investment, "where it ideally should be." Valli added: "This is the role that impact investors can play – to bring it to this level."

For enterprises in earlier stages of business development, convertible structures – a hybrid investment wherein debt is converted into equity at predefined terms – are an attractive vehicle due to their flexibility and speed of issuing. Don Purka commented that: "Convertible structures are a very good path forward that allows flexibility for an equity investor to come in, but still the entrepreneur gets to maintain control of his company."

"Convertible structures are a very good path forward that allows flexibility for an equity investor to come in, but still the entrepreneur gets to maintain control of his company."

In addition, this investment strategy can be very useful where an equity valuation is not strategic or cannot be agreed upon. Valli explained: "Where the evaluation has differed between Bamboo Finance and the entrepreneur, the approach is: let's push it to the future and link it to performance milestones."

Santosh Kumar highlighted that convertible structures are underutilised: "Most of the small entrepreneurs don't understand and are not even aware that this is an option. More education is needed in this, and financing institutions need to raise more awareness about this." Purka added that explaining convertible structures to public financiers has been

a challenge, and that this area would benefit from concerted training efforts.

Donning the enterprise perspective, Giri described an interesting financing structure that Gham Power is exploring in a pilot project, incorporating blends of soft loans, local private investments and grants. In Nepal, commercial banks have a strict lending policy around the presence of physical collateral, "i.e., land for that project." To meet this requirement as well as to promote local commitment to the project, a handful of village investors will be investing around 15% of the costs. Gham Power plans to use concessional loans from the commercial lending sector to meet some of the financing needs. In addition, Giri explained, "We are treating any grant money coming in as an equity investment on behalf of the community. So any dividend made from that equity, we put into a CAPEX [capital expenditure] fund for system expansion and to help keep tariffs low over time." The project lifetime is 25 years, but the investment return horizon is only 10 years to pay back investors. To bridge this time gap, the CAPEX fund will help pay to maintain and adapt the system throughout this time.

Addressing investment risks and unlocking affordable financing for the sector







A better understanding of the real financial risks associated with mini-grid projects is also needed. Kumar commented: "What we really need to have from the financing institution side is a recalibration of their risk perception of the sector. A lot of risks are unnecessarily magnified by financial institutions." Drawing parallels to the scepticism that commercial lenders initially showed the micro-finance sector, Kumar contended that, "none of the banks agreed that lending could be made without collateral. It took 10 years to get risk out of the bank's assessment. Now they all agree. As the private mini-grid sector is only 5-6 years old and commercial lending is just trickling in, it will take some time to have risks recognised and understood so that they can be minimised." Wiemann added that the finance sector wants to engage but "does not yet see critical mass for this market and wants to see some reliable data". Knowledge-sharing initiatives like the Clean Energy Mini-Grids HIO and Energy Access Practitioners Network are key for aggregating and disseminating this type of data to investors eager to examine mini-grid track records and project pipelines.

Purka highlighted the key role of development finance institutions (DFIs) in delivering technical training to commercial banks in order to break risk barriers. ADB has been active in this capacity for decoding other renewable energy investment risk, and now is beginning to do trainings on energy access. *“We encourage other DFIs to get out there and do this. If we don’t capture that commercial bank market, there will still be a huge deficit on the debt financing side.”*

An evolving market increasingly attracting investor attention

In this emerging space of renewable energy-based mini-grids, a multitude of variables defines the strategy for deploying business models and

financing schemes. From project size to ownership structures and local community capacities, this varying set of parameters can make the market hard to navigate for entrepreneurs, investors and policy makers alike. The sector is seeing rapid innovations in technologies used to address key issues, such as payment collection, and is experiencing evolving business models and financing structures. As Anu Valli stated, *“We are confident about this space because of the need, the market size and the depth, which allows for multiple companies and business models to co-exist and operate.”* Concerted efforts to understand and tackle risk will help push the sector towards maturity and capitalise on growing financing commitments to the sector.

MODERATOR	PANELISTS				
 <p>Don Purka</p> <p>Director, Infrastructure Finance Division 1, Private Sector Operations Department, ADB</p>	 <p>Marcus Wiemann</p> <p>Secretary General, Alliance for Rural Electrification</p>	 <p>Anu Valli</p> <p>Investment Manager, Bamboo Finance</p>	 <p>Sandeep Giri</p> <p>CEO, Gham Power, Nepal</p>	 <p>Tripta Singh</p> <p>Deputy Director, Energy Access Initiative, UN Foundation</p>	 <p>Santosh Kumar</p> <p>Technical Expert, Indo-German Energy Programme, GIZ</p>

Session 6

Financing energy access initiatives: mobilising finance and establishing the right delivery mechanisms

KEY ACTION POINTS

- » Identifying the right channels and mechanisms to deliver financing is highly context-specific. It requires a careful examination of the stage of market development, domestic financing institutions and the funding needs of enterprises and end-users.
- » To improve access to finance, actions are necessary both upstream (*i.e.* introducing financing instruments that are compatible with the scale of off-grid projects) and downstream (*i.e.* improving bankability of projects through approaches like aggregation).
- » Coordination between rural electrification programmes is necessary to maximise the impact of available resources and avoid duplication of efforts.
- » Adequate financing instruments need to be increasingly deployed to address funding gaps, reduce risks and unlock commercial and private finance. Moreover, local commercial finance institutions need to be better engaged to provide and channel funds.
- » Channelling finance from international sources requires a focus on simplifying processes and *calls for proposals*, in order to ensure that the financing is accessible to a broad range of enterprises operating in the off-grid sector.
- » Risk mitigation tools, such as publicly backed guarantees and currency risk insurance, play a crucial role in unlocking investments in the sector.

Globally, an increasing amount of capital is being mobilised for energy access by multilateral development banks, development agencies and governments. Private sector investors are also investing increasingly in the space. This is leading to a general perception that capital is available on the upstream side. However, as evidenced through the previous sessions, there is a clear need to streamline the dispersion of funds in a manner that meets the diverse needs of those seeking finance, in terms of the scale and the investments.

As more capital is mobilised upstream, governments and financing institutions are tasked with designing new (or calibrating existing) mechanisms to be able to absorb and make financing accessible to a largely fragmented set of actors in the sector.

The session featured voices from an international organisation, a multilateral development bank, a private

sector enterprise and government institutions – all key stakeholders in this discussion. They discussed how an efficient and effective “source to end-use” financing mechanism can be established and what the roles of different stakeholders are in this process.

Introducing the financing challenge: mismatch between terms of lending and borrowers’ needs

The money is there, according to many financiers, but the energy access market is not able to absorb it. Susan McDade, Country Actions Team Leader of the SE4ALL Initiative, highlighted: “*If we were in a room of financiers from capital markets, they will say the world is floating in money. Capital can’t find good projects to invest in. There is no shortage of money. Money is not the problem.*” Although capital commitments to energy access are increasing, extending these resources to the right actors is complex.

As McDade aptly commented: “At every stage of the financing horizon, there are different barriers.” On the one hand, the financial infrastructure and services in many rural contexts are missing or are difficult to access. On the other hand, much of the financing available today is not stimulating a broader market transformation, due mostly to mismatches in scale (the investment size on offer compared to the financing needs) and in the terms of financing on offer. McDade noted: “If I go to a project developer, they will say I cannot get money for my project. The money is very hard to get to. The rules, writing the proposals, the conditions that the lender puts, are very hard for me – I cannot get to this money.” She added: “There are also very big challenges in consumer financing, not just enterprise financing.”

At the community level, variations in income related to factors such as the season’s harvest or remittances make traditional methods of financing systems difficult. IRENA’s online survey of regional stakeholders provides further insights into the access-to-finance challenge and clearly identifies risk perceptions among financial institutions and lending terms as the key barriers (see Figure 4).

The challenge for the international community now is to identify ways to tackle the various barriers.

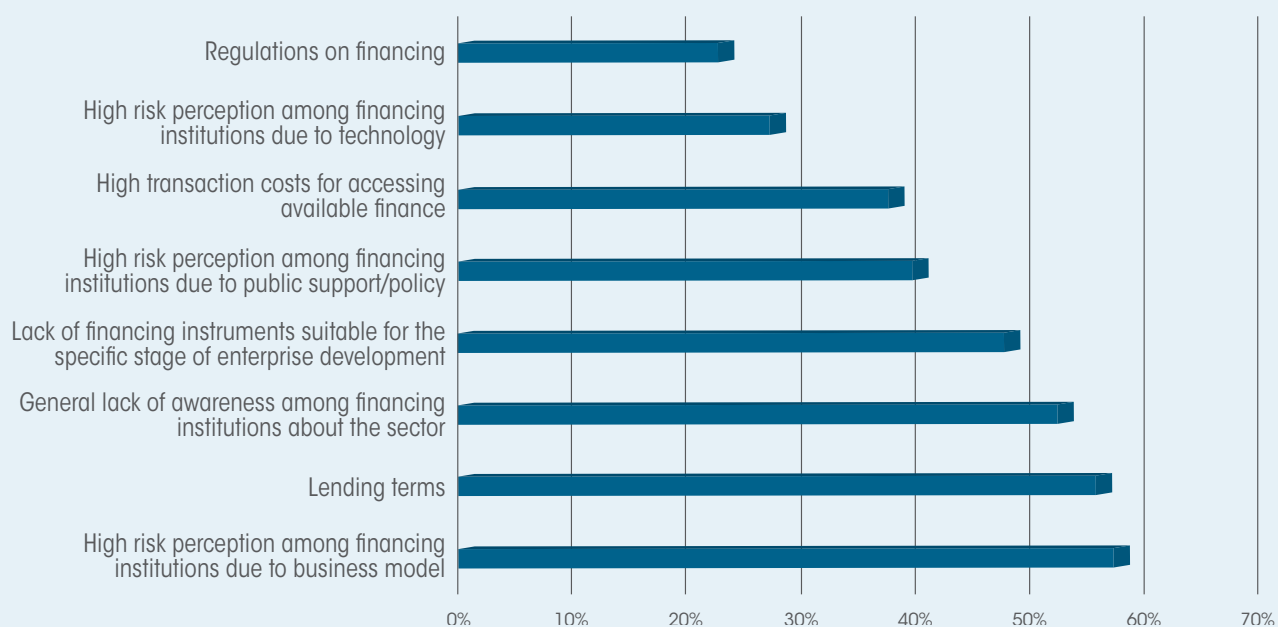
Delivering finance: breaking it down

To better understand the various barriers in financing, it is useful to examine three major issues in delivering finance to end-users and enterprises. First, the channels through which the financing reaches users need to be identified. Second, the mechanisms by which financing is delivered needs attention: what are the instruments that are used? Third, the capacity of the actors involved – such as financing institutions, enterprises and end-users – to cultivate financial channels and use these mechanisms underlies the successful delivery of finance.

Channels

Creating conduits to deliver money that is earmarked at the international and national level to enterprises and end-users is a challenging task. With so many different needs and business models among those seeking financing, platforms for dispersing funds require high flexibility. Sarah Alexander of SELCO India commented: “We really have to break down the conventional way in which this is done.” Alexander explained how SELCO has worked through intermediaries to deliver finance to end-users and partner enterprises. Working with local banks, SELCO facilitates a loan to pay for

FIGURE 4. WHAT ARE THE PRIMARY REASONS BEHIND THE “ACCESS TO FINANCE” CHALLENGE? (% OF TOTAL RESPONDENTS*)



* RESPONDENTS COULD CHOOSE UP TO FOUR ANSWERS

the solar home system that the customer can pay off in 3-5 years.

While India has benefited from a strong network of village banks, in the absence of such a network there are still intermediaries available to work through. When facing the unwillingness of local banks to lend, Alexander explained that SELCO has *“tapped into community organisations, set up revolving funds through some kind of flexible money. There are ways that people are meeting their own financing needs locally. If you look into this, you may find groups of women who are lending, joint liability groups or traditional financing groups in certain communities.”* Alexander noted that if banks view these projects with community groups as successful, they may agree to be lenders to replicate the programme elsewhere.

“If we were in a room of financiers from capital markets they will say the world is floating with money. Capital can’t find good projects to invest in. There is no shortage of money.”

“If I go to a project developer, they will say that the money is hard to get to. The rules, writing the proposals, the conditions that the lender puts make it very hard to get to the money.”

Roberto Ridolfi, Director of Sustainable Growth and Development with the European Commission’s Directorate-General for Development and Cooperation, agreed about the importance of forming strategic partnerships with local institutions to reduce risk. For developers moving into new markets, local NGOs and community organisations are *“the best partners to electrify that village.”* For example, partnering with a local NGO trusted in the community can lower security risks and the costs of customer relationship management. In addition, including donors and those involved in government

“We should promote this recipe of partnerships between those who know the community and can solve problems dealing with poverty and access to finance, those who know technical issues, and those who know how the government works in a country – put these forces together. This is a practical solution to put in place.”

is key to understanding the regulatory environment and obtaining licences and permits as smoothly as possible. *“We should promote this recipe of partnerships between those who know the community and can solve problems dealing with poverty and access to finance, those who know technical issues, and those who know how the government works in a country – put these forces together. This is a practical solution to put in place.”*

Addressing larger lenders, Alexander challenged these institutions to think of new ways to route finance: *“How can we start challenging the way conventional guarantee funds are brought down to the enterprise or end-user? Is there a better way to do this, and are there intermediaries we can tap into? Channels of routing financing is something we need to focus on more.”*

“How can we start challenging the way conventional guarantee funds are brought down to the enterprise or end-user? Is there a better way to do this, and are there intermediaries we can tap into? Channels of routing financing is something we need to focus on more.”

In essence, channels address the accessibility dimension of the financing challenge. But it is the mechanisms themselves that determine whether the financing being pushed through the channels meets the needs of end-users and enterprises. The importance of this synergy is evident from the case of Cambodia, which has enacted a programme that has attempted to recognise the need for appropriate channels as well as match the right mechanisms to the characteristic of a project. Loeng Keosela, Executive Director of the Rural Electrification Fund in Cambodia, highlighted that because commercial banks in the country require collateral and sizeable interest rates for loans, the Rural Electrification Fund Department was set up as a non-profit wing of the national utility, Electricité du Cambodge, to provide accessible financial support and incentives for rural electrification.

Mechanisms

The financial mechanisms, or instruments used to deliver finance, constitute a toolbox for addressing the specific needs of those seeking capital. Weighing in on the types of mechanisms needed to leverage commercial finance and facilitate private sector involvement in energy access projects, Ridolfi

noted: *“For energy access, we need patient capital. That’s what the European Commission is planning to do, and asking SE4ALL to convene other partners on, so we can mobilise a massive worldwide facility”* to provide subordinated debt finance to these types of projects.

The programme referred to in this session was recently launched by EuropeAid as the Electrification Financing Initiative (ElectriFI)². A key feature of the programme is the use of convertible grants that convert into subordinated debt. This flexible mechanism allows for long-term subordinated debt that can accommodate diverse business models from both private and public institutions. In its assessments, the European Commission has identified a lack of available equity in developing countries as a key hurdle. This initiative creatively tries to tackle this: subordinated debt can qualify as equity to senior debt lenders, thus helping to fulfil equity requirements for projects, while developers maintain ownership and are not subjugated to equity yield expectations. With an initial EUR 75 million allocated, the fund could grow considerably, with additional funding from national or regional allocations and through partnerships with other donors and investors.

The key challenge for many funds is the question of the minimum ticket size of investments. The funding gap, especially for debt, in many developing countries is in the tens of thousands (and a few hundreds of thousands) of dollars. Many international development funds are looking for much higher investment ticket sizes, of at least a few million dollars – and for a valid reason. Financing smaller projects means more costs and resource inputs during due diligence, monitoring and other relevant stages.

Alexander highlighted that applications for financing can take from three months to 1-2 years for vetting and approval by financial institutions, also severely limiting their usefulness to enterprises and end-users. *“The way in which some of these cumbersome processes happens needs to be challenged in many ways. Money is available, but by the time it reaches the people that it’s supposed to reach, it just takes too long.”*

As such, process standardisations and business plan templates are being used increasingly to smoothen out the processes and reduce resource

inputs. Also increasingly discussed is the use of aggregation as a tool to allow such financing to be used to benefit smaller projects while at the same time address risks.

“The way in which some of these cumbersome processes happens needs to be challenged in many ways. Money is available, but by the time it reaches the people that it’s supposed to reach, it just takes too long.”

Chingiz Orujov, Senior Energy Economist at the Islamic Development Bank (IDB), described IDB’s partnership with Fonds de Développement de l’Électrification (FDE), the national rural electrification agency, in Burkina Faso. The partnership is centred on bundling projects for financing. *“They bundle these small projects into one package”*, Orujov explained. Individual project sites are bundled into a USD 10-12 million project covering 40-50 villages. Once a proposal is agreed upon, IDB finances the project, and the government agency splits the finance into different projects in the communities and trains the community in operating generation assets.

Moving to end-user financing, a simple yet effective mechanism used in India, showcases how international funding can be deployed through local channels with enhanced outreach. In 2003, the United Nations Environment Programme (UNEP) worked with Syndicate Bank and Canara Bank, two Indian national banks, to create an interest subsidy. The banks provided end-user financing with an interest subsidy of 5% to purchase solar products from vetted quality suppliers, with around 18 000 households reached in two years. *“It was a huge impetus to the way end-user financing took off in Karnataka”*, noted Alexander. *“UNEP, a large organisation, tapped into two banks. It was really local and it was able to reach out to a lot of people.”*

Alexander described some of the ways in which SELCO has used simple mechanisms to facilitate funding. Although SELCO facilitates financing for customers with village banks, sometimes the loans that banks offer do not make payment for the system possible. For example, in some cases the bank has asked for a 25% down payment. In these circumstances, SELCO has used soft or flexible funding to cover the down payment and avail the loan. In other cases, an entrepreneur will want to buy a large order of systems to sell or rent in a village and is not

²See *“Working Paper: Electrification Financing Initiative (ElectriFI)”*, http://capacity4dev.ec.europa.eu/sites/default/files/file/25/09/2014_-_1430/20140922-182032_working_doc_electrifi_doc.pdf.

able to access a loan from the bank to make this possible. In response, SELCO may put a risk guarantee on the loan for the bank. After this first entrepreneur and the loan's demonstrated success, SELCO may reduce or completely remove the risk guarantee in further loans of this nature with the bank. "So, we're trying to find what the barrier is for banks to give funding to end-users, and use our funding to target that particular barrier, rather than reduce the cost of the system so it's easier for them to do a cash sale", Alexander explained.

Grants are commonplace in the energy access space today. Instead of utilising grants or making them available for capital investments, there are several cases now where they are converted into revolving funds, which has a positive impact on the sustainability of the projects. Nafees Ahmad Khan, Advisor on International Cooperation with the Alternative Energy Development Board (AEDB), explained that recently, AEDB facilitated a mini-grid project for 100 households in Pakistan, but a contentious missing piece of the project is the mechanisms to cover operation and maintenance costs and make the project sustainable. "Maybe we need to devise a revolving fund through community-based organisations that can help to make this project sustainable", commented Khan.

Khan also noted that there is huge potential for converting agricultural irrigation pumps which run primarily on diesel fuel to solar water pumps. Of 1.2 million existing irrigation pumps, 600-700 have been converted to solar pumps, with much promise for converting more.

Capacity building

Once effective channels are established and mechanisms are identified, capacity building targeted at all stakeholders is crucial to ensure effective financing. Financial institutions, especially at the local level, often are not ready to finance systems due to perceived risks. Increasing awareness of the economics of renewable energy systems, building strong partnerships and providing tangible evidence of success can go a long way in addressing the risk perceptions prevalent among the financial institutions. There is also a need to align the language between investors and enterprises, as Alexander highlighted: "We have to really think about terms of engagement that we talk about here. On whose terms do we talk about scale and how big projects need to be? We need to start some of these conversations and address what the realities are in the field." For capacity building

among entrepreneurs, targeted assistance in project preparation and loan management would contribute greatly to reducing banks' hesitancy to provide loans.

Drawing on the IDB experience in Burkina Faso, Orujov described the success factors that made the partnership with the rural electrification agency work, and how it can be replicated in other countries: "This model can be replicated provided that there is a strong Rural Electrification Agency in the country and that a good training programme is in place for building capacity of co-operatives." In addressing the shortfall in the estimated USD 45 billion annually needed to ensure universal energy access by 2030, Orujov emphasised the importance of engaging and building up capacities of local financial institutions: "We believe that most of the financial resources for the energy access sector in the future should come from local financial institutions."

"To develop conduits to deliver commercial capital to the sector, international finance institutions must engage and support capacity building with local banks."







To develop conduits to deliver commercial capital to the sector, international finance institutions (IFIs) must engage and support capacity building with local banks. For example, IDB provided a line of financing to a state-owned bank in Turkey that provided small-scale loans for energy efficiency. Such an approach helps local banks gain experience and engage with the sector. Orujov highlighted that the same approach can and should be used in other countries: "This is the way to go forward because we [IFIs] don't have that much money. We have to develop local capacity of financing."

Concluding remarks

From the discussions in this session, some broad principles can be drawn. "Financing depends on financing for what and at what scale", said McDade. As shown, varying electrification strategies – grid extension, solar home systems, mini-grids – require different amounts of capital and different mechanisms to hedge against their specific risks. A mini-grid project involving both generation and distribution assets and multiple stakeholders requires different vehicles for financing than a solar home system programme. In addition, there are

different “colours of financing”, such as start-up capital, consumer finance, etc. These different categories

of finance attend to different businesses and stages of business development.

MODERATOR	PANELISTS				
 <p>Susan McDade Country Actions Team Leader, SE4ALL Initiative</p>	 <p>Loeung Keosela Executive Director, Rural Electrification Fund, Cambodia</p>	 <p>Nafees Ahmad Khan Advisor – International Cooperation, Alternative Energy Development Board, Pakistan</p>	 <p>Sarah Alexander SELCO, India</p>	 <p>Roberto Ridolfi Director – Sustainable Growth and Development, Directorate-General for Development and Cooperation – EuropeAid, European Commission</p>	 <p>Chingiz Orujov Senior Energy Economist, Infrastructure Department, Islamic Development Bank</p>



Session 7

Off-grid renewable energy technology: design, innovation and integration

KEY ACTION POINTS

- » Technology innovation is key not only to ensure the reliability and performance of off-grid renewable energy systems but also to enhance the economic viability of such solutions.
- » Innovation need not be limited to generation or collection models alone, but can also include storage and demand management, which play a key role in ensuring stability of supply in off-grid systems.
- » Hybridising diesel mini-grids is economically viable in most cases. Islands are serving as laboratories for technology and management strategies to integrate high shares of variable renewables, with lessons for other off-grid projects.
- » Innovative collection models, for example based on pre-payment technologies, represent promising solutions and the potential for widespread application.
- » Building trust in systems is key for the growth of off-grid markets. Adequate standard and quality frameworks need to be in place to ensure that systems deployed are able to operate reliably and safely under off-grid conditions.
- » As demand for off-grid systems grows, opportunities for local industry development rise. Tapping into these opportunities requires specific policy and financial instruments that adapt to maturing markets and are backed by strong monitoring frameworks.

Technology options for rural electrification have a crucial role to play in expanding electricity access in remote areas. As advances in technology have driven down the cost of renewable energy components, equally important leaps in off-grid business models and power system management have been enabled.

Opening the session, Dolf Gielen, Director of the Innovation and Technology Centre at IRENA, introduced the scope of topics to be discussed, spanning the current state and outlook of off-grid technologies, economics of hybrid diesel-renewable energy mini-grids, island grid stability strategies and payment systems for solar home systems.

In this session, the panellists explored the impact of technology improvement in accelerating the deployment of renewable energy in off-grid areas and delved into future trends in off-grid technology developments.

Hybridising mini-grids: technology considerations

Mini-grids have a range of applications, providing electricity services for rural communities, mines, defence applications, remote businesses, islands and telecommunications towers. Due to converging factors of renewable energy price declines, rising fossil fuel costs and leaps in off-grid technology, hybridising existing diesel mini-grids with renewable energy sources has become a popular cost-saving technique. Emanuele Taibi, Island Roadmap Analyst at IRENA, commented: *“There is a strong economic case for this and technologies that allow you to do a lot in this area.”*

Wilhelm van Butselaar, Sales Director of Hybrid Energy Solutions at SMA, described the technology considerations behind a smoothly operating PV-diesel-hybrid mini-grid. When integrating a PV component into a diesel mini-grid, its interaction with the diesel generator is very important. To co-ordinate

electricity dispatch and load management, a fully integrated communication system is necessary. Van Butselaar noted how operators of diesel mini-grids can be cautious to hybridise as they do not want their diesel systems tampered with. To address this issue, *“the solar system does not tell the existing diesel generators what to do. It only listens to it and reacts to it accordingly.”* Van Butselaar explained: *“We do this because we can’t underload a diesel generator.”*

Hybrid mini-grid design must also ensure that diesel generators are not overloaded. If a cloud passes over the solar PV array and shifts all the load to the generators, the system has to be prepared to ramp up generation via batteries or additional generators. This need for precise control and coordination is what separates these projects from a normal grid-connected solar project, says van Butselaar. *“You have to have an intelligent controller in the system.”*

Technology for high penetration levels of renewables

For off-grid systems integrating variable renewable sources, system stability is a major consideration. To address this issue, technological solutions have arisen that can be strategically applied to enable a wide spectrum of variable renewable energy penetration levels.

For solar PV, the level of penetration – the ratio of PV nominal power to generator nominal power – affects the degree of sophistication for a system. Van Butselaar explained that with up to 20% PV penetration, a generator will have an accommodating spinning reserve to deal with load fluctuations. Above 20% PV penetration, a control mechanism is needed that coordinates the power outputs of the solar system and generators. Control systems can accommodate up to 60% PV penetration without the need for storage. However, van Butselaar commented: *“Load profiles define if you have to use storage or don’t have to use storage.”* In certain circumstances, storage may be needed at this penetration level to accommodate load fluctuations and seasonal variability.

For 100% penetration, it was stressed that a “grid manager” is needed. PV systems are sized above 100% capacity to ensure total coverage with solar power and to relegate a diesel generator to solely provide backup power. These 100% renewable systems require both storage and a grid-interacting

inverter to assist with regulation of voltage and frequency. *“The message here is that there are technological solutions available today”*, stated Taibi. *“These are already deployed in many cases, and this is the case when we are looking at high penetration of renewables.”*

When designing a hybridisation project, Taibi highlighted that, *“the cost of integration is not linear”*. The marginal cost of hybridising a diesel system increases as the share of variable renewables increases. As a system reaches higher levels of solar, more sophisticated controls and possibly storage is needed, driving up costs per kW installed. *“It’s a matter of looking at the economics as they evolve and what technologies can help you in integrating higher shares of renewables.”*

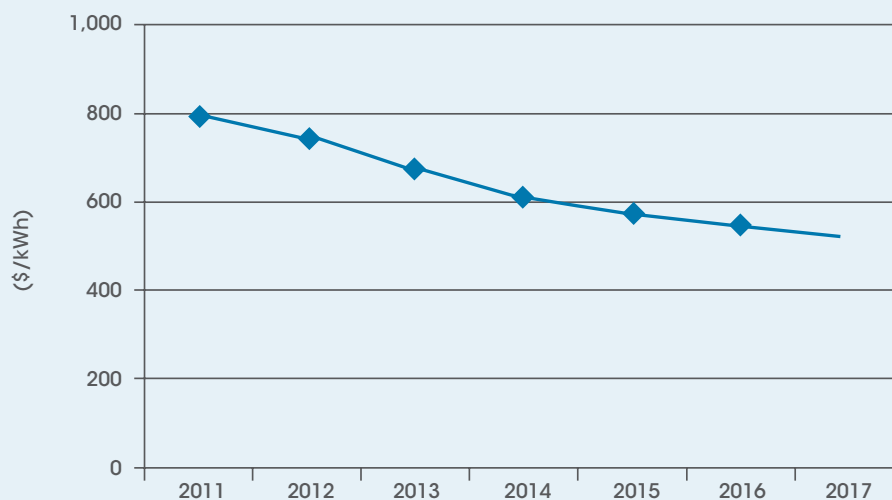
“The message here is that there are technological solutions available today”

Electricity storage for off-grid renewable energy integration

In off-grid and island contexts, storage is a technology component that can be integral to system stability. As PV panel prices have dropped precipitously, storage costs are similarly falling, albeit at a much slower speed. Although established lead-acid battery technologies have not seen substantial price drops, lithium-ion batteries are seeing a steady decline in price, projected to drop from USD 800 per kWh in 2011 to an expected USD 500 per kWh by 2017 (see Figure 5). *“New technologies are coming up quickly, promisingly, and prices are dropping rapidly”*, stated Taibi.

For larger-scale grids, pumped hydro storage is still the cheapest option. Although rare, pumped storage has seen applications in off-grid storage, such as in the wind-pumped hydro system commissioned in summer 2014 in El Hierro, Canary Islands. However, it was highlighted that, moving forward, batteries will probably take a lead role. It was also emphasised that, when designing for storage components in a mini-grid, smart design using complementary technology options for grid stability and ancillary services can minimise overall costs. Although storage can still be expensive, *“you probably need less than what you think if you have good control systems in place”*, stated Taibi.

FIGURE 5. LITHIUM-ION BATTERY SELLING PRICE ON THE WORLD MARKET, 2011-2017 (ADAPTED FROM PIKE RESEARCH)



Grid stability strategies: a look at islands

As islands see a growing volume of solar projects due to attractive irradiation levels and high electricity tariffs, energy sector stakeholders are raising concerns about the effect of large shares of renewables on grid stability. IRENA is working with island power utilities to analyse the impacts of high penetration of renewables on grid stability and to make recommendations for technology and management strategies to accommodate high shares of variable renewables.

Solutions in place today allow for the integration of more and more renewables in existing grids. Beyond storage, a suite of technology options exists to support stable operation of the grid. These include additional generation to provide operational reserves, advanced controls for diesel generators and demand-side management. In terms of off-grid innovation, it is not just about generation technology, pre-payment business models and technology, but also about demand technologies. Demand management that strategically lessens electricity loads will play a key role in ensuring grid stability moving forward, especially as smart-grid components become more commonplace.

Some present-day examples were highlighted at IOREC to illustrate technology and management solutions in place. The island of Tokelau in the South Pacific generates 92% of its energy from solar, with 8% from diesel backup under consideration for

replacement with biodiesel. To facilitate such large shares of variable electricity, OPzS lead-acid batteries have been deployed as a storage solution. Looking towards the future for the island, this system is only the beginning and modularity will be key. Within a short time frame, demand has already increased by 40%. Innovating affordable and easily integrated generation and storage scale-up solutions will be integral to system stability over time. In the Canary Islands, El Hierro aims to reach 100% renewable energy production utilising wind and pumped hydro storage.

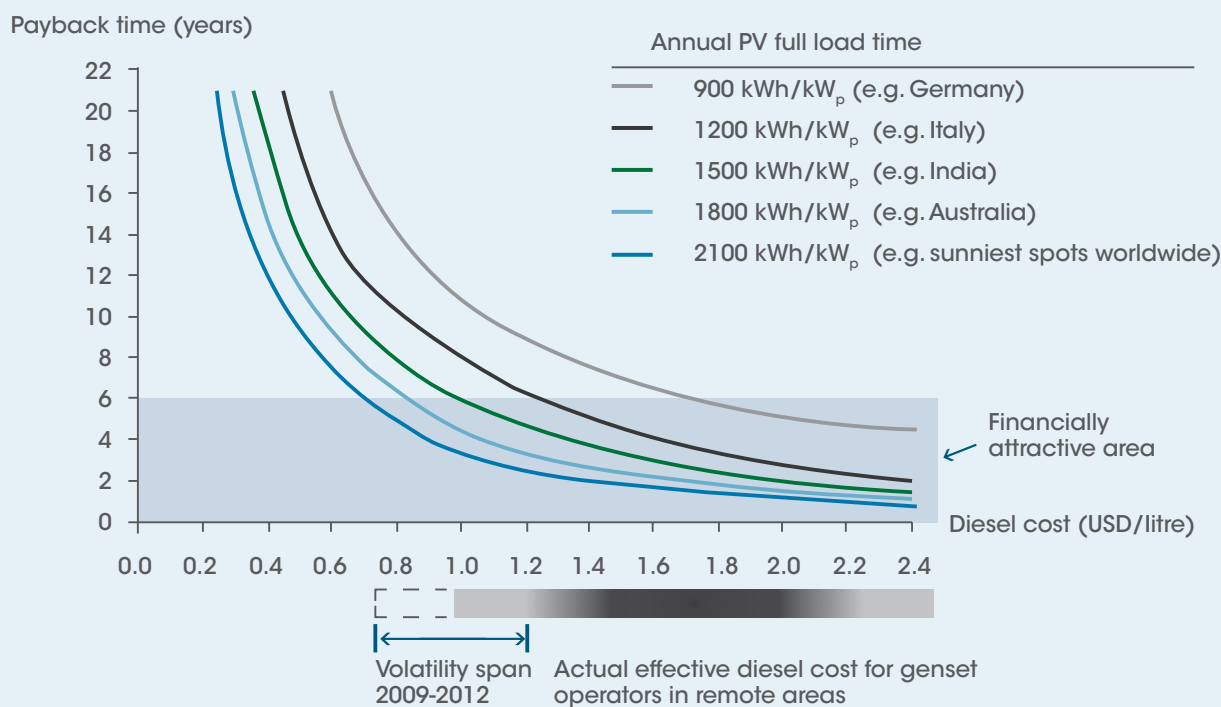
Mini-grids: determining economic and financial viability

Already today, significant cost advantages of PV-diesel-hybrid systems exist compared to conventional diesel generation in many circumstances. However, the economics are very site specific and rely on a diversity of project characteristics. What factors determine economic viability? Panellists emphasised the role of diesel prices, cost of capital and solar irradiation on project economic viability. Van Butselaar explained: *“If the solar irradiation is high and the diesel cost is above USD 1 per litre, it makes a lot of sense to add a solar system because, overall, the maintenance costs of your system will be much lower.”* Highlighting the need for a quick payback period to attract investors, van Butselaar showed how these factors converge to present projects with 4-5 year payback periods (see Figure 6).

Silvia Kreibiehl, Head of the Frankfurt School-UNEP Centre, drew upon experiences from an ongoing study conducted by the Frankfurt School for UNEP, Siemens and IRENA, assessing the economic viability of hybridising larger-scale brown-field diesel power plants with solar PV. In addition to the aforementioned factors, Kreibiehl highlighted how project size and load characteristics are main variables in project viability. According to the preliminary results of the study, “*everything below 2 MW seems to become relatively expensive because the system integration investment is relatively high*”. For larger projects, economies of scale allow for minimising the costs of project planning, financing, equipment supply, and operation and maintenance. Kreibiehl emphasised that the load profile also influences viability. For industrial loads, peak solar PV overlaps with peak electricity needs during daylight hours. In contrast, mini-grids serving residential loads are slightly harder to hybridise economically and technically because peak load occurs at night, creating mismatches of load supply and demand.

Kreibiehl highlighted that an important distinction needs to be made between economic and financial viability. Economic viability evaluates whether it makes sense for the economy and a utility to shift to a hybrid system, such as when cost can be avoided by producing electricity using solar over diesel. Financial viability considers when it makes sense for an investor to invest, based on the revenue level from hybridisation. The distinction was made clear when Kreibiehl showed the reality for tariff and feed-in tariff (FiT) structures at potential project sites. While many projects are economically viable, low FiTs that do not cover the price of electricity production preclude financial viability. “*The existing PPAs [power purchase agreements] and FiT hardly address the specifics of hybrid solutions, so there needs to be a bilateral negotiation of a PPA.*” Kreibiehl explained: “*Avoided cost of the diesel would be a good remuneration level for the hybrid system. Given that economic viability is there, the utility or government should also have an interest to agree to such a PPA.*”

FIGURE 6. PAYBACK TIMES FOR HYBRIDISING A MINI-GRID CONSIDERING IRRADIATION LEVELS AND DIESEL FUEL PRICE (ADAPTED FROM SMA AT IOREC)



From viability to reality

With an eye on the next stages of the study on *'Economic viability of hybridising larger-scale brown-field diesel power plants with renewables'*, Kreibiehl presented key considerations for implementing hybridisation projects. In particular, economic viability is being seen in the majority of projects. Access to double-bottom-line capital that considers both economic and social or environmental benefits, or concessional financing from DFIs, will make investments even more attractive.

Ownership structure is another consideration. The majority of the mini-grids being assessed are owned by public utilities. To attract private finance sector investment, utilities need to be willing to sell their existing generation assets to an IPP. Alternatively, a utility could keep its assets and hybridise the system using balance sheet financing.

Lastly, while economic viability is present in most projects, financial viability still needs to be created at some sites as PPAs and FiT schemes do not address the specifics of hybrid mini-grids. Absent a policy framework that considers mini-grid business models, an adapted PPA or tariff scheme to allow viability may need to be negotiated.

Solar home systems: technology, innovation and local content

Bangladesh is a widely cited example of a successful programme rollout for solar home systems, and Rahimafrooz has been a major player in this success. With over 65 000 systems deployed per month nationally, the market is thriving, and the government has set lofty targets for the near future. Even so, as Munawar Misbah Moin, Managing Director of Rahimafrooz Renewable Energy Ltd, highlighted: *"Every good story has its challenges, and I will show you the challenges we are facing to move from the 3 million already installed to the 6 million we want to do by 2016."*

To begin, Moin laid out the programme elements in place that have allowed for a rapid and sustained scale-up in solar home system installations thus far. Trust in product quality is key: the systems deployed have a robust design and high-grade components. Moin explained: *"From the very beginning, we had good-quality panels, tubular lead-acid batteries, lights and charge controllers. All the global players were present in Bangladesh."* As demand

heightened, however, certain components began to be manufactured locally. Today, all of the components are produced domestically.

Moin noted how batteries used in the system were the largest challenge at first. The national solar home systems programme stipulated that batteries last five years, while at the time the technology did not have this track record of durability. *"Back in 2000, there were not many people in the world who were willing to give such guarantees in remote, rural areas"*, Moin explained. The battery industry took up this challenge, and there are now batteries in the field lasting beyond nine years.

In designing the industry for self-sufficiency, nominal grant components with declining support were used. Moin highlighted that this was a positive element that allowed for initial industry support, but self-reliance with time. Starting with grants covering 20% of system costs, this support has fallen to 5% and is limited to systems below 30 Watts. Underpinning all of these elements has been a strong monitoring platform ensuring consistent standards in all aspects. On a quarterly basis, IDCOL monitors the 47 partner organisations on technical standards, creditworthiness and business operations to safeguard the stability of the programme.

Challenges going forward: collection and cost of collection

As Rahimafrooz scales up operations, it faces challenges that it believes can be overcome with technological innovation. Moin explained: *"The technical issue that we need to innovate for right now is the field challenges we are facing in terms of collection and cost of collection."*

"The technical issue that we need to innovate for right now is the field challenges we are facing in terms of collection and cost of collection."

Currently, payment collection and handling expenses make up a staggering 75% of all logistics costs for the company. In addition, worrying trends signal that a new solution to collection methods may be necessary. While overall collection efficiency remains at 90%, monthly collection efficiency has dropped steadily from 57.8% in 2010 to 44.6% in 2013.

Presently, the company is handling USD 3-10 per month for 2.5 million customers, creating numerous hassles around cash collection. To address these challenges, Rahimafrooz has turned an eye towards a mobile-based pre-payment system that aims to eliminate cash handling. Additional benefits include reduced risks of default, establishment of customer accountability to pay, and reduction in costs of collection. Bangladesh has a mobile penetration rate of 95%, so Moin highlighted this strategy as a currently viable solution and strategic move going forward. The company is now piloting a pre-paid solar home systems programme with 100 systems deployed.

In its pilot programme, Rahimafrooz has rolled out two different types of payment technology: the Localised Keypad-Based Controller and the Automated Payment-Based Controller (see Table 1). The Localised Keypad-Based Controller features a physical keypad on the solar home system where a specialised code is entered to activate the system. The end-user purchases credit for the system through a local agent selling scratch cards or through mobile money. This scheme is similar to purchasing mobile credit, and can therefore be easily adopted. The Automated Payment-Based Controller does not have an interface, but is credited automatically once the end-user






pays for electricity credit through a mobile money account.

Currently, the Automated Payment-Based Controller may not be feasible due to the added costs of embedding a GSM component with a SIM card to communicate with Rahimafrooz payment systems. However, if additional services, such as remote system monitoring, complemented the price hike, this extra layer of intelligence may be worth the extra costs for interested end-users.

As Rahimafrooz eyes moving into the mini-grid market, Moin highlighted a strong correlation between the pre-paid solar home system pilot and mini-grid development. As customers are introduced to the concept of metering and mobile electricity payments with solar home systems, the transition to mini-grids that use metering technology will run much more smoothly, reducing training and user difficulties. Overall, Moin underlined that pre-paid meters will bring a “significant breakthrough” in how the solar home systems programme is rolled out and managed in Bangladesh. With their rollout, they will complement the growth of solar home systems, ensure better financial management at the point of sale and minimise risks associated with cash handling.

TABLE 1. PRE-PAID SOLAR HOME SYSTEM TECHNOLOGIES

LOCALISED KEYPAD-BASED CONTROLLER	AUTOMATED PAYMENT-BASED CONTROLLER
<ul style="list-style-type: none"> <li data-bbox="268 1422 724 1518">» End-user purchases monthly credit through scratch card and inserts the number into key pad. <li data-bbox="268 1563 724 1659">» End-user purchases credit by mobile cash and gets number through solar home system for key pad. 	<ul style="list-style-type: none"> <li data-bbox="906 1422 1347 1518">» End-user purchases credit by sending payment via mobile cash channel. <li data-bbox="906 1563 1347 1659">» Automated server remotely activates the system for the credit period.

MODERATOR	PANELISTS			
 <p>Dolf Gielen, Director, Innovation and Technology Centre, IRENA</p>	 <p>Munawar Misbah Moin Managing Director, Rahimafrooz Renewable Energy Ltd</p>	 <p>Silvia Kreibiehl Head, FrankfurtSchool – UNEP Centre</p>	 <p>Emanuele Taibi Island Roadmap Analyst, Innovation and Technology Centre, IRENA</p>	 <p>Wilhelm van Butselaar Sales Director, Hybrid Energy Solutions, SMA Australia</p>



Closing Remarks

Anthony Jude

Senior Advisor and Chair,
Energy Community of Practice,
Asian Development Bank

Off-grid renewables can be a win-win solution for developing countries in addressing energy access. The challenges of energy security and climate change all weigh heavily on Asia today, and the impact will become even greater in the coming years. The discussions during IOREC tell us that off-grid renewables are not a myth. They are becoming a reality in many developing countries. As a regional development bank, we see our role as helping the scale-up of such projects. ADB supports IOREC's focus on seeking business solutions for energy access. We believe that entrepreneurs that target the bottom of the pyramid, the millions that are unserved, are pioneers in an untapped market – one that existing utilities simply cannot reach with their models.

SE4ALL has set ambitious energy development targets. By 2030, this initiative is targeting the Holy Grail of energy development achievements: universal access by 2030. It aims to bring the benefits of modern energy to millions and is trying to accomplish this by increasing energy efficiency programs and expanding deployment of renewables, of which off-grid systems will play a major role. Through its close partnership with national governments, SE4ALL will be able to guide new policies that can form a framework for energy access and greater renewable energy deployment. Shaping policy in support of off-grid development is one of the next steps that has to be taken.

IOREC represents a new stage in the co-operative efforts between ADB and IRENA. We aim to maintain this level of co-ordinated action in the future as we partner for future activities focused on sharing and spreading knowledge on energy access. All of which will contribute to the solutions that make access to energy available to the millions of unserved in an environmentally friendly and sustainable manner.

Ernesto Macías

President,
Alliance for Rural Electrification

Since the last IOREC conference in Ghana, we have seen a significant evolution. We are seeing even more participation from the private sector, which is absolutely key. We have experienced intense and high-level discussions over the past two days. One of the key conclusions is that mini-grids will become a major segment within the sector in the coming years. Technologies are continually evolving and improving to enable energy services to be delivered in a cost-effective manner, as we have seen from the exhibitors at the conference.

In regards to business and financing models, we need to keep finding ways to substantially scale up deployment in this sector. There is no single solution, but we need to explore mechanisms to attract financing from financial institutions. There are young companies and young entrepreneurs coming together with the pioneers, people who have been working in this sector for years. All together, we need to exchange information. We need to take solutions and information and go directly to the governments and highlight that these specific solutions are available and effective to provide electricity.

It is very clear that we have experienced a great evolution in these last two years, and we can expect a much bigger improvement in the coming ones. In the meantime, we need to join efforts and exchange information, because this will strengthen the renewable energy sector.

Adnan Z. Amin
Director-General,
International Renewable Energy
Agency

Over the past two days, we have witnessed a lively and enriching discussion on the different facets of off-grid renewable energy development. There is general consensus that off-grid renewables represent a cost-effective, clean and reliable option to expand electricity access in rural, peri-urban and island contexts. Achieving universal access to modern energy services by 2030 will require us to substantially accelerate the deployment of off-grid renewable energy.

To ensure that the sector can achieve scalability, we will need dedicated policies, enabling regulations, access to the required financing, tailor-made business models and adapting technologies. In doing so, each one of us as policy makers, financing institutions, developers, NGOs, inter-governmental agencies and other stakeholders has to work within a collaborative framework to address barriers to off-grid renewables deployment.

We need to devise customised solutions to provide reliable and clean energy to cater to both basic and productive energy needs. The benefits of off-grid renewables extend beyond just electricity provision alone and cut across sectors, including health, water, telecommunication, education, etc. A more holistic approach is therefore necessary when we think about energy access – we need to focus not only on basic services but on the entire potential for stimulating socio-economic development.

IRENA is committed to supporting governments in creating an enabling environment that allows the necessary scale-up in renewables deployment. In this effort, we seek the continued support of the broader community to engage with us through the IOREC platform and to contribute to the collective effort of providing solutions to existing challenges.

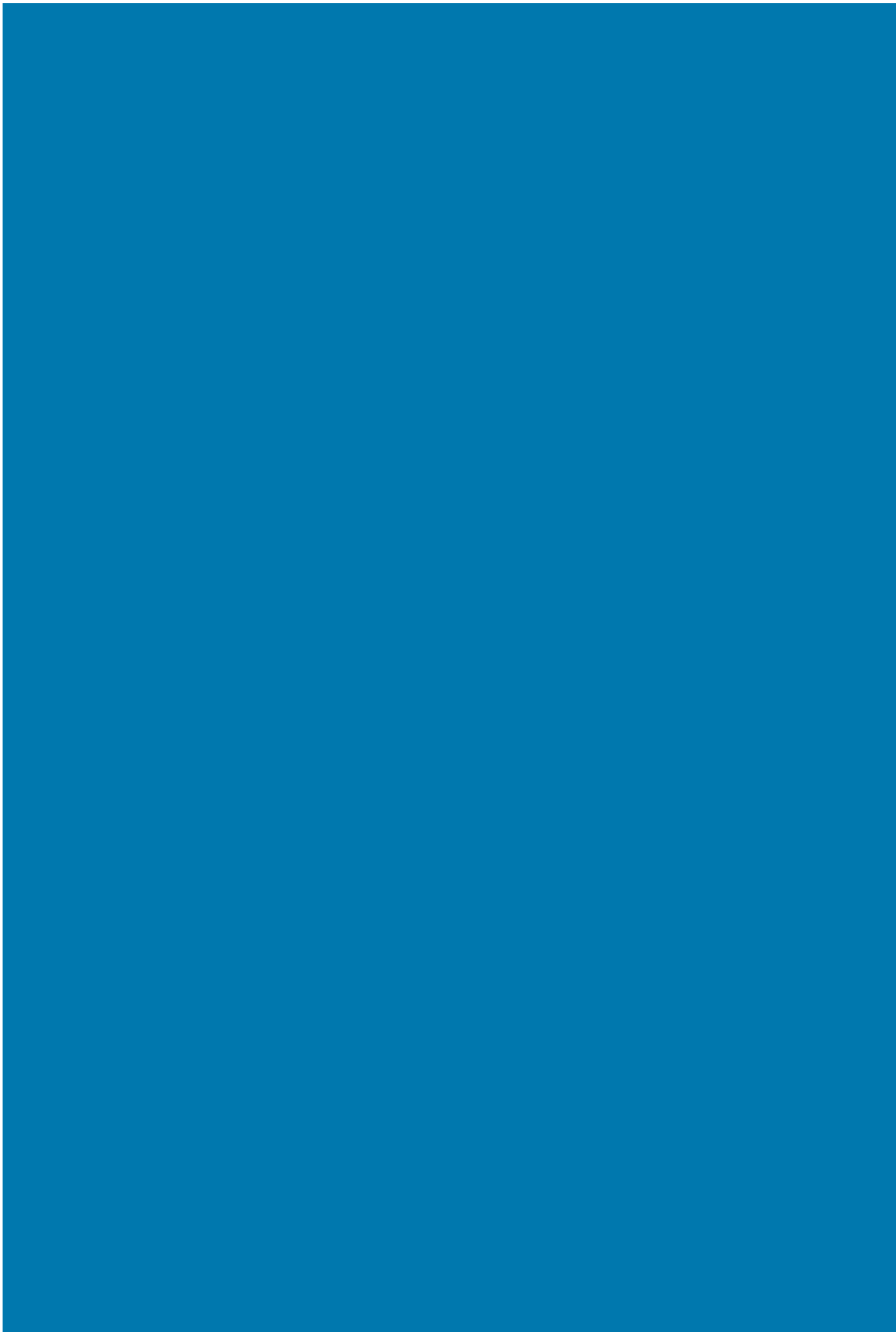
Annex 1. Conference Agenda

DAY 1 – 16 JUNE 2014	
08:00-09:15:	Registration
Opening Ceremony	Welcome Remarks:
09:15-10:00	<ol style="list-style-type: none"> 1. Wencai Zhang, Vice President, Asian Development Bank 2. Adnan Z. Amin, Director-General, IRENA 3. Ernesto Macías, President, Alliance for Rural Electrification
10:00-10:15	<i>MoU signing ceremony between IRENA and Asian Development Bank</i>
10:15-10:30	<i>Key messages from IOREC 2012: Salvatore Vinci</i> , Programme Officer – Policy Advice, IRENA
Bridging the electricity access gap sustainably and rapidly: the role of stand-alone renewable energy solutions	
Session 1	Developing markets for stand-alone renewable energy systems: insights into policy and regulatory aspects
10:30-12:00	<p>Moderator: Kandeh K. Yumkella, Special Representative of the UN Secretary-General and Chief Executive for the Sustainable Energy for All initiative</p> <p>Panellists:</p> <ol style="list-style-type: none"> 1. Hardiv Harris Situmeang, Executive Director, ASEAN Centre for Energy 2. Farzana Rahman, Unit Head (Investment), Renewable Energy, IDCOL, Bangladesh 3. Marcus Wiemann, Secretary General, Alliance for Rural Electrification 4. Jiwan Acharya, Senior Climate Change Specialist, Asian Development Bank 5. Andy Schroeter, Director, Sunlabob Renewable Energies, Laos
Lunch	Exhibition
Session 2	Developing markets for stand-alone renewable energy systems: insights into financing and business models
14:00-15:30	<p>Moderator: Akanksha Chaurey, CEO, IT Power India</p> <p>Panellists:</p> <ol style="list-style-type: none"> 1. Peter Ballinger, Director, U.S.-African Clean Energy Development and Finance Center, OPIC 2. Dipal C. Barua, Managing Director, Bright Green Energy Foundation, Bangladesh 3. Paul Needham, President and Co-founder, Simpa Networks, India 4. Roderick De Castro, Executive Director, Team Energy Foundation Inc., Philippines 5. Srey Bairiganjan, Project Manager, Arc Finance
Coffee Break	Exhibition
Session 3	Socio-economic impact of off-grid renewable energy deployment: meeting basic and productive needs
16:00-17:30	<p>Moderator: Robert F. Ichord Jr., Deputy Assistant Secretary, U.S. Department of State</p> <p>Panellists:</p> <ol style="list-style-type: none"> 1. Aaron Leopold, Global Energy Advocate, Practical Action 2. Laurie Navarro, President, CleanEnergy Solutions International, Philippines 3. Soma Dutta, ENERGIA International Network on Gender and Sustainable Energy 4. Iskandar B. Kuntoadji, Co-founder, IBEKA, Indonesia 5. Dagmar Zwebe, Sector Leader Renewable Energy – Vietnam, SNV Netherlands Development Organisation 6. Divyam Nagpal, Junior Professional Associate, Knowledge, Policy and Finance Centre, IRENA
Exhibition	
Networking and Reception	

DAY 2 – 17 JUNE 2014

Mini-grids: harnessing the opportunity for meeting electricity needs and stimulating socio-economic development

Session 4 09:00-10:30	<p><i>Developing markets for renewable energy-based mini-grids: insights into policy and regulatory aspects</i></p> <p>Moderator: Gauri Singh, Director – Country Support and Partnerships, IRENA Panellists:</p> <ol style="list-style-type: none">1. Li Zhiwu, National Research Institute for Rural Electrification & Division Chief, Hangzhou Regional (Asia & Pacific) Center for Small Hydropower, China2. Nawaraj Dhakal, Assistant Director, Alternate Energy Promotion Centre, Nepal3. Brian Shaad, Co-founder, Mera Gao Power, India4. Nico Peterschmidt, Managing Director, INENSUS5. Rana Adib, Policy Advisor, REN21 Secretariat
Coffee Break	Exhibition
Session 5 10:45-12:15	<p><i>Developing markets for renewable energy-based mini-grids: insights into financing and business models</i></p> <p>Moderator: Don Purka, Director, Infrastructure Finance Division 1, Private Sector Operations Department, ADB Panellists:</p> <ol style="list-style-type: none">1. Marcus Wiemann, Secretary General, Alliance for Rural Electrification2. Anu Valli, Investment Manager, Bamboo Finance3. Sandeep Giri, CEO, Gham Power, Nepal4. Tripta Singh, Deputy Director, Energy Access Initiative, UN Foundation5. Santosh Kumar, Technical Expert, Indo-German Energy Programme, GIZ
Lunch	Exhibition
Session 6 13:15-14:45	<p><i>Financing energy access initiatives: mobilising finance and establishing the right delivery mechanisms</i></p> <p>Moderator: Susan McDade, Country Actions Team Leader, SE4ALL Initiative Panellists:</p> <ol style="list-style-type: none">1. Loeung Keosela, Executive Director, Rural Electrification Fund, Cambodia2. Nafees Ahmad Khan, Advisor – International Cooperation, Alternative Energy Development Board, Pakistan3. Sarah Alexander, SELCO India4. Roberto Ridolfi, Director – Sustainable Growth and Development, Directorate-General for Development and Cooperation – EuropeAid, European Commission5. Chingiz Orujov, Senior Energy Economist, Infrastructure Department, Islamic Development Bank
Coffee Break	Exhibition
Session 7 15:15-17:00	<p><i>Off-grid renewable energy technology: design, innovation and integration</i></p> <p>Moderator: Dolf Gielen, Director, Innovation and Technology Centre, IRENA Panellists:</p> <ol style="list-style-type: none">1. Munawar Misbah Moin, Managing Director, Rahimafrooz Renewable Energy Ltd2. Silvia Kreibiehl, Head, Frankfurt School – UNEP Centre3. Emanuele Taibi, Island Roadmap Analyst, IRENA4. Wilhelm van Butselaar, Sales Director Hybrid Energy Solutions, SMA Australia
Closing Remarks	
17:00-17:30	<p>Anthony Jude, Senior Advisor and Chair, Energy Community of Practice, ADB Ernesto Macías, President, Alliance for Rural Electrification Adnan Z. Amin, Director-General, IRENA</p>
	Exhibition





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