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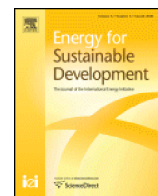
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Achieving universal energy access and rural development through smart villages



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ABSTRACT

With just 12 years to go to 2030, progress in providing universal energy access and improving rural development outcomes in many rural areas has been too slow if the Sustainable Development Goals are to be met. Over a three-year period, the Smart Villages Initiative gathered evidence and views from over 1000 stakeholders from 70 countries to identify the framework conditions necessary for the provision of energy services to rural communities and to ensure that energy access translates into improved rural development outcomes. This short communication provides an overview of the key findings of this process and suggests a number of “bottom-up” insights and recommendations. These include taking an integrated approach to rural development, building markets to leverage the private sector, creating supportive, coherent and flexible policy frameworks at the national-level; and a re-think of financing mechanisms.

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Introduction

Over 1 billion people remain without access to electricity and 3 billion people cook on inefficient dirty stoves (IEA, 2016): the vast majority live in rural areas. Progress in providing rural access to sustainable modern energy has been too slow if Sustainable Development Goal (SDG) 7 (universal energy access to all) is to be met by 2030 (UN, 2015). A rapid and substantial increase in the rate of deployment of energy services to rural communities is needed.

A key premise of the Smart Villages Initiative¹ is that the required acceleration must be founded on a more integrated approach to rural energy access in which increased emphasis is placed on the use of renewable energy and modern information communication technologies (ICT) to enable productive enterprises and the provision of key services, and in which more effective partnerships are established

between governments, development bodies and the private sector (Holmes, Jones, & Heap, 2015).

The Smart Villages Initiative has identified framework conditions necessary for the provision of energy services to rural communities to enable livelihood opportunities, provision of services (healthcare, education, clean water and sanitation) and the empowerment of rural communities. In the Smart Villages concept, provision of sustainable energy services to rural communities, can have a catalytic impact on the lives of villagers when appropriately integrated with other rural development initiatives. Smart villages provide many of the benefits of 21st Century life to rural communities, and reflect a level of rural development consistent with achieving the SDGs.

Research methodology

A two-year scoping study (Bailey, Henriques, Holmes, & Jain, 2012) identified the benefits of a more holistic approach to energy access and identified the key question for policy and practice: how to establish framework conditions to enable that more holistic and integrated approach, accelerating the deployment of sustainable energy services to catalyse rural development. A significant gap between practitioners and those responsible for policy and funding was also identified, with a need to combine insights of these diverse groups in order to address the key challenges.

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¹ The Smart Villages Initiative (www.e4sv.org) focuses on off-grid energy for rural development and has been undertaken by an interdisciplinary team based at the Universities of Cambridge and Oxford in the UK. The Initiative has been funded by two charities - the Cambridge Malaysian Education and Development Trust and the Templeton World Charity Foundation - and has been undertaken in collaboration with the networks of national science academies in Africa, Asia, America and Europe.

From 2014 to 17, the Smart Villages Initiative organised more than 30 consultation workshops in Africa, Asia, Latin America and Europe involving frontline workers (entrepreneurs, NGOs, development organisations, villagers and civil society organisations), policy makers and regulators, the finance community, and international experts in science, engineering and social science. The workshops gathered evidence and views from over 1000 stakeholders from 70 countries, using a systematic approach to identifying, discussing and synthesising responses to key questions, and giving a 'voice' to frontline practitioners that has been conveyed to relevant audiences in the global South and North through policy briefs, meetings, seminars and joint policy statements with the networks of national science academies. The workshops were complemented by webinars, research projects (see, for example, Van Gevelt, Canales-Holzeis, Jones, & Safdar, 2016; Van Gevelt, Canales-Holzeis, George, & Zaman, 2017), media and forward look workshops, competitions for young entrepreneurs, and reviews of the literature providing some degree of triangulation with the views and experiences discussed at the workshops.²

A core set of questions were addressed at each workshop. These questions focus on identifying barriers and how they can be overcome, and distill key conclusions and recommendations to be conveyed to policy makers. This was augmented by local issues identified by workshop participants. Additional questions were considered according to the regional context of the workshops and the specific focus of some workshops (for example, on the water-energy-food nexus, energy supply to islands, and cookstoves). Iterative development of responses through presentations, plenary and breakout discussions culminated in a final plenary session at each workshop in which key conclusions and messages were agreed upon. The process of synthesis across the workshops identified cross-cutting findings supported by practical evidence of experience.

Achieving smart villages

The extensive programmes of engagement have provided up to date insights from the 'frontline' on the challenges of rural energy access for development (embodied in becoming 'smart villages') and how those challenges can best be addressed. These 'bottom-up' insights and recommendations are summarised in this section.

Taking an integrated approach

A consistent message from the workshops was that, typically, village level development initiatives - for example on energy access, connectivity, health and education, productive enterprise etc. - are undertaken separately and with little or no coordination. Consequently, potential synergies are missed and the full development benefits of energy access are not realised.

Workshop participants considered that the current silos need to be replaced by a more integrated approach addressing the development of villages holistically. Participants further stated that rural and urban development should be addressed within an integrated planning framework which stimulates and intensifies connections between villages and cities and that future interventions in villages will typically provide greater development benefits if designed to address several SDGs rather than only one SDG.

In order to realise this more integrated approach, much better levels of collaboration are needed between the key players: for example, across government ministries, and between the different levels of governance (local, regional and national), and the public and private sectors. Within governments, appointment of senior champions with the authority to establish the required integrated working can be helpful. Effective academic support is also needed, requiring

interdisciplinary collaboration between the natural, social and engineering sciences.

A particular concern, often expressed by frontline workers, was the lack of coordination between international development organisations resulting in many rounds of calls for proposals for relatively small amounts of funding, each addressing particular elements of the overall rural development challenge. Better coordination between development organisations is needed with the aim of providing a more seamless experience for frontline workers, reducing their transaction costs and enabling them to scale up their activities.

Building markets

There was increasing evidence from participants that, given supportive framework conditions, the private sector can make an important contribution to rural energy access. Governments and development organisations have a key role to play in supporting the creation of effective markets and ecosystems of players (including manufacturers, distributors, retailers, operators, financiers etc.) to realise the contribution of the private sector. In contrast, schemes which provide energy technologies to villagers for free, hamper the creation of such markets and undermine the sustainability of businesses. They have repeatedly been shown not to work, and they can prolong a counter-productive handout mentality in rural communities. To the extent that subsidies are used to enable access by the poorer segments of rural communities, they need to be carefully targeted and set up so as to complement rather than cut across commercial endeavours.

In some areas such as East Africa, technologies that provide energy services at the individual household level - pico-solar lights, solar home systems and clean cookstoves - are increasingly being sold on a commercial basis achieving rapid rates of deployment scale up. Business models based on 'pay-as-you-go' or 'pay for services' approaches, together with big reductions in the costs of solar PV and increases in the efficiency of appliances have enabled this breakthrough. As costs continue to fall and appliance efficiencies increase, a greater proportion of rural communities will be able to buy into these technologies.

These technologies operating at the household level can make an important contribution by getting households onto the first level of energy access more quickly, particularly for dispersed populations (Alstone, Gershenson, & Kammen, 2015; Sovacool, 2012; Van Gevelt et al., 2016). With universal electricity access by 2030 as the target, the rate of deployment must be further accelerated. In order to do so, the commercial companies spearheading current progress need to have better access to affordable finance, support from government and development agencies in establishing the necessary skill base, and to build distribution networks, potentially in collaboration with other organisations providing products and services to rural communities.

The step up to the higher levels of electricity access that can be supplied by mini-grids is largely motivated by their ability to support productive enterprise. For now, mini-grids typically require some level of subsidy. However, the entrepreneurial drive, capacity to sustain the operation and maintenance of schemes over time, and capability to undertake vital engagement with villagers of the private sector point to its important role in moving beyond pilot schemes to the wide-scale and rapid deployment necessary to meet the 2030 universal energy access target. Effective public-private-community partnerships are needed, supported by well targeted and time-limited subsidies focusing on capital rather than operational costs.

Workshop participants repeatedly stressed the importance of support from governments and development organisations to reduce mini-grid costs (including through technical developments, economies of scale, reducing setup overheads and financing costs) and to increase revenues (through appropriate tariffs, stimulating productive enterprises, and increasing the load factors and level of connections of schemes). Over time, these developments should reduce the levels of

² The underpinning workshop and technical reports, together with the individual workshop presentations and policy briefs are available at www.e4sv.org.

subsidy required, potentially leading to fully commercial operation of mini-grids in due course.

A key requirement for building effective markets and enabling the contribution of the private sector is that the actors have the requisite skills and capacities. However, it was clear that shortfalls in skills and capacities continue to act as a brake on the deployment of rural energy technologies and their use in supporting productive enterprise and key services. Such skills and capacities are a 'public good', and it therefore falls to governments, supported by development organisations, to take the lead on building them.

Working with local businesses, governments and development organisations may appropriately take the lead on evaluating all stages of value chains to identify shortfalls in skills and capacity; training programmes then being put in place to fill the gaps. Government ministries responsible for education, business innovation and development, agriculture, and health need to collaborate with energy ministries in identifying and satisfying the need for training programmes.

Front-line entrepreneurs emphasised the value of business incubation and advisory support services: governments and development bodies may usefully invest in them, and set up training programmes for rural entrepreneurs in how to run a successful business. Successful examples were presented where technical training and vocational institutions have been set up and run by governments in partnership with entrepreneurs.

A valuable contribution of international development organisations is to support governmental capacity development, including through sharing of experiences between countries. Initiatives are also needed to increase the capacity of the finance sector to evaluate village level projects to supply and productively use energy.

Villagers were frequently unaware of available off-grid technologies, the consequent opportunities for productive enterprises and ways to increase the productivity of their existing activities. Workshop participants considered that governments, development bodies and NGOs could therefore continue to undertake initiatives to increase villagers' awareness of these aspects as 'seeing is believing' and successful pilots and examples of smart villages need to be promoted to snowball success through replication and imitation.

Supportive policy frameworks

Historical examples of successful rural electrification initiatives in countries as diverse as Chile, China, Costa Rica, South Korea, Thailand and Tunisia demonstrate that effective and supportive policy and regulatory frameworks can enable rapid rural electrification reaping substantial development benefits (Bhattacharyya & Ohiare, 2013; Cecelski, Dunkerley, Ouanalli, & Aissa, 2007; McAllister & Waddle, 2007; Tuntivate & Barnes, 2007; Van Gevelt, 2014). To be effective, such policy frameworks need to ensure that initiatives on energy access are fully integrated with other aspects of rural development and are backed by high-level political commitment which is sustained through political cycles.

Conclusions of the workshops were that policy and regulatory frameworks need to be stable and supportive, provide clarity on the roles of relevant government departments, and establish effective mechanisms to coordinate their inputs. Coherent policies are required, firmly based in realities, and regulations should provide for simplified and streamlined procedures in order to reduce transaction costs incurred by all players, not least the private sector. National energy access plans, setting out which areas are planned to get access to the national electricity grid and to Liquefied Petroleum Gas (LPG) distribution networks, and on what timescales, have been demonstrated to enhance coordination and to provide confidence to private investors.

Regulations on off-grid tariffs need to enable cost recovery by developers if the private sector is to play a role in rural electricity provision: this may require some hard choices given the tensions between the affordability of subsidies and considerations of equity between rural

and urban customers. Tax exemptions and a minimum of red tape can enable entrepreneurs to get their businesses off the ground. Governments may usefully set up 'one-stop shops' (as, for example, in Rwanda) providing a single point of access for licensing and approvals processes, and for the provision of information and advice.

Access to finance

In order to achieve universal electricity access and deployment of clean cooking technologies by 2030, the rate of investment needs to be increased substantially. Given the limitations on funding available from governments in developing countries and from development organisations, much of this additional funding will need to be found from the private sector (Malhotra, Schmidt, Haelg, & Waissbein, 2017; Schmidt, Blum, & Wakeling, 2013).

Workshop participants suggested that governments and development organisations should undertake systematic reviews of sustainable energy supply and use value chains in order to identify, and plug, any financing gaps. Particular concerns are debt and equity financing for early-stage companies, and the availability of funding in local currencies. In order to reduce interest rates on loans and to make private sector funds more available, an effective approach can be for governments and development bodies to provide credit guarantees in some form. Governments and development bodies may usefully work with private finance organisations to increase their familiarity with the off-grid energy sector.

For companies selling pico-solar lights and solar home systems, one approach would be for concessional donor funds to finance credit risk on the basis that customer repayment records are collated and (appropriately anonymised) made public, thereby building the evidence base of the creditworthiness of the pay-as-you-go sector.

All stakeholders need to work together to reduce the transaction costs for companies seeking financing to implement projects and to expand, and for banks, investment bodies, and development organisations which finance projects to supply and use off-grid energy. Potential mechanisms include bundling of projects for financing, and the formation of cooperatives at the village level. Action should be taken to address the fragmented nature of the funding landscape: one option is to set up a development and innovation fund which can provide a high profile and single focus for financing to enterprises.

Discussion

Limited resources mean that investments in rural communities need to be carefully targeted, investment decisions being informed by analysis and effective engagement with local communities. Workshop participants emphasised that communities should be in the 'driving seat' in respect of the development path taken by their villages, and care must be taken not to impose development paradigms that are incompatible with local desires and cultures (see, for example, Van Gevelt et al., 2017).

It is important also to recognise that there is not a simple binary choice between villages and cities; in reality, there is a distribution of population across all size levels of habitation which we may expect to change over time. Productive enterprise (or at least some types of productive enterprise) may most appropriately be located in rural towns or larger villages, or in clusters of villages. Such rural concentrations of productive enterprise may achieve the requisite critical mass and avoid some of the diseconomies associated with many cities in developing countries. Some level of intra-rural migration may be anticipated as a result.

History suggests that rural electrification and development can be achieved rapidly if a well-focused and integrated approach is taken. For example, in South Korea over a ten-year period from 1970 levels of rural electrification went from low to high levels, and household incomes increased by a factor of nearly 10 (Van Gevelt, 2014). In this

case, government initiatives on rural electrification were accompanied by initiatives to increase agricultural productivity and rural value added, and to develop rural industry. Care must be taken in interpreting such historical examples as the global economic circumstances now may not be so conducive to rapid rural economic progress as it was then (Collier, 2008). On the other hand, developing countries are not so encumbered by outmoded infrastructures as developed countries and have opportunities to leapfrog to technologies and infrastructures capable of taking full advantage of 21st century opportunities.

At the village level, the findings from workshops showed repeatedly that the development agenda and associated actions need to be driven by the villagers, mentored and supported by development bodies, NGOs, government agencies and other stakeholders. Mechanisms are needed whereby actors concerned with energy access, village services, agriculture, and productive enterprise can work together to ensure a holistic approach to village development which can turn potential synergies between sectors into realities. Such mechanisms should provide for systematic evaluation of the distinctive challenges and opportunities inherent in each village setting. Standard but flexible processes and analytical frameworks are required, rather than blueprints.

Conclusions

Achieving access to energy and rural development will require smart villages to become the norm, not the exception, for rural communities. With just 12 years to go to 2030, it is crucial that lessons on how a positive and steep spiral of development, with energy access as its catalyst, be learned and shared rapidly. The Smart Villages Initiative, through its workshops-based approach, has brought many of these lessons to the forefront. Moving forward, in order to bring together stakeholders and mobilise the necessary resources, many of the lessons that have come out of these workshops need to be better understood and rigorously verified. While a significant evidence-base exists based on case-study literature there remains a paucity of larger-N (natural/quasi-) experimental studies that are able to rigorously evaluate scalable approaches to providing energy access and the mechanisms required to ensure that access to energy is used productively and translates into improved rural development outcomes. Findings from such studies can help build the necessary evidence-base required to move policy forward and meet the Sustainable Development Goals.

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