Remote but productive

Using energy access investments to catalyse enterprises and income in Tanzania's rural communities

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Working paper
December 2016

Energy

Keywords:
Energy access, productive uses of energy, agriculture

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Acknowledgments

IIED and Hivos would particularly like to thank staff at CEFA, ACRA, JUMEME and Energy 4 Impact for agreeing to participate in the research and their tireless efforts in facilitating and reviewing our work. These include Davide Ceretti and Marco Tancredi at ACRA; Dario De Nicola, Jacopo Pendezzo, Francesca Baravelli, Evanton Willilo and Virgilio Kiwhele at CEFA; Adam Mbwambo, Fredrick Mushi and Simon Collings at Energy 4 Impact; and Nico Peterschmidt at INENSUS.

We would also like to thank the Rural Energy Agency for enabling us to hold a stakeholder workshop at their offices in May 2016 to consult on the draft paper. We are grateful for all the individuals from the energy sector and in the communities who participated in our research and provided useful feedback at the workshop. Sisty Basil (Energy Change Lab co-ordinator), Latif Amars, Calistus Kavindi and Tupokigwe Kibona helped greatly with workshop organisation, arranging the fieldwork and translation.

Published by IIED, December 2016.

Best, S., Garside, B. (2016) Remote but productive: Using energy access investments to catalyse enterprises and income in Tanzania's rural communities. IIED Working Paper. IIED, London.

http://pubs.iied.org/16627IIED

ISBN: 978-1-78431-434-7

Printed on recycled paper with vegetable-based inks.

Photo caption: Using electricity for oil pressing: Esther Msafiri, LUMAMA customer, Milo village, Njombe region

Photo credit: IIED

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While rural energy access investments – like mini-grids – can be expected to transform local economies, this doesn't happen automatically. Catalysing local enterprises and raising incomes through productive uses of energy often requires extra measures, to overcome barriers such as gaps in local people's skills or financial resources. In Tanzania there are huge opportunities for ambitious energy access investments to increase rural productivity, including milling, irrigation and small and micro-enterprises. This paper examines the experiences of two mini-hydro projects in Njombe region run by NGOs, and a solar-diesel mini-grid project in Tanzania's lake zone run by a joint venture company. All three are exploring ways to combine energy with wider rural development processes. The paper investigates what interventions work, and offers recommendations for new entrants, policymakers and funders.

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Summary

Policymakers and citizens often have high expectations that rural energy access investments will transform local economies; but this does not happen automatically. Catalysing productive uses of energy (PUE) often requires extra measures to overcome barriers, such as gaps in local people's skills or financial resources. In Tanzania there are huge needs and opportunities for ambitious energy access investments to increase rural productivity – for instance to support milling, irrigation and small and micro-enterprises. Some mini-grid developers in Tanzania are already testing ways to combine energy with wider rural development processes. A challenge for new entrants, policymakers and funders is to understand what interventions work and how to support these.

This paper examines the experiences from two mini-hydro projects in Njombe region, initiated by the Italian non-governmental organisations (NGOs), the European Committee for Training and Agriculture (CEFA) and ACRA, which are now run by the community utilities Matembwe Village Company (MVC, under CEFA) and LUMAMA (under ACRA). It also examines JUMEME Rural Power Supply Ltd, a joint venture company which has recently started a solar-diesel mini-grid project in Tanzania's lake zone. In addition, it includes perspectives from consultations with stakeholders from across the energy sector, including at a seminar held in Dar es Salaam in May 2016.

Our aim is to share learning and generate discussion among policymakers, development partners, developers, the private sector and civil society organisations in Tanzania. We ask: **what interventions could help ensure that new mini-grid and other energy access investments create jobs and livelihood opportunities for Tanzania's citizens?**

The research is an activity of the Energy Change lab (www.energychangelab.org), a multi-stakeholder initiative founded by Hivos and IIED. The CEFA and ACRA **case studies** were selected for their experience in stimulating PUE, their similar contexts and their readiness to engage with the research. JUMEME provides a useful comparator as a private company facing similar challenges but in a different region and as a more recent start-up.

Our research identifies several interesting features of the CEFA, ACRA and JUMEME approach:

- The NGOs and community utilities are **driven by a social mission** and have a wider perspective than energy supply, encompassing community development, agriculture and environmental conservation. This creates the possibility for the type of **joined-up thinking needed for rural development processes**, which an energy developer on its own might struggle to achieve. JUMEME is also quite holistic in its approach and invests in stimulating customer demand. It carries out its own support activities with customers and through partnering with NGOs and consultants.
- All three organisations have tested **various types of promotional work which fit with typical good practice recommendations**, such as awareness-raising and enabling funding to support local businesses to buy electrical equipment. They have also tested **non-traditional approaches** such as: involving local people in managing the utility; establishing an integrated power-agro-processing business; allocating electricity purchasing 'rights' to incentivise low-price milling; and designing an investment prospectus to attract external investment into the locality.
- Investments by CEFA and ACRA have **helped stimulate local economic development**, particularly in the areas of **agro-processing, agro-forestry and local services, as well as in the household sector**. For JUMEME it is too early to assess outcomes, though there is potential in the fishing, horticulture and service sectors. All the projects face **ongoing challenges** such as users' business skills and access to finance, value chain data gaps, barriers to supporting women's entrepreneurship, and non-energy bottlenecks in value chains which make it hard for small enterprises to convert their electricity into increased productivity and incomes (eg poor roads).
- Both CEFA and ACRA are building on their experience **to develop larger-scale projects and delivery models that partner with the private sector**, combining economic and social objectives.

The research identifies several key challenges and recommendations, explored further in Section 8.

CHALLENGE: Building demand by combining energy with an integrated rural livelihoods approach can increase local impacts, but this wider mandate involves time, expertise and costs.

- *Recommendation 1: Developers need to invest in local awareness-raising and capacity-building – done by the right organisations.* Energy providers need to understand their customers to design a viable and sustainable service. Locally based NGOs can bring crucial expertise and relationships, but there may still be a gap around local organisations that have expertise in rural business development.
- *Recommendation 2: Energy access funders and knowledge platforms should support collaboration between developers and rural enterprise advisory services.*
- *Recommendation 3: Support for local enterprises needs to be targeted and informed by a robust PUE assessment, and new good practice guidance tailored to local contexts.* A key risk is trying to support too many initiatives with insufficient resources. Developing and promoting good practice guidance for Tanzania stakeholders on conducting PUE assessments for specific local contexts and sub-sectors, and designing support measures, could improve targeting.

CHALLENGE: It takes time and money to promote PUE to low-income and marginalised groups, beyond the timeframes or risk profiles of many projects, lenders and investors.

- *Recommendation 4: Proper budgeting and increased grant funding and patient capital is needed to incentivise PUE.* Key activities that need funding include: PUE assessments; support measures and delivery model innovation; addressing user affordability constraints; and measuring PUE outcomes. Developers also need to introduce clear budget lines on PUE promotion.
- *Recommendation 5: Innovators in finance for micro, small and medium-sized enterprises and smallholders should share expertise and experience with the energy access sector.* This could help address the end-user finance gap.
- *Recommendation 6: Policymakers, funders and developers should support partnerships and collaborations to help to scale up impacts.* Collaborations range from the holistic to narrow; multi-stakeholder to more private-sector led; project-specific to sector or area-wide interventions. We need to understand the incentives and barriers to collaboration, support different approaches and understand what works in different contexts.

CHALLENGE: Tanzania has an enabling environment for energy access, but specific policy measures may be needed to accelerate productive energy use.

- *Recommendation 7: Increase cross-sector co-ordination, policy signals and financial incentives to promote more integrated approaches to energy access and rural development.* This applies to government ministries and other institutions key to rural development, such as financing institutions. Mechanisms include cross-sector performance targets, sharing sectors' development plans and using REA grants to fund PUE assessments and support services.
- *Recommendation 8: Governments and funders can support innovation through facilitating access to advice, guidance and networking.* In Tanzania, new mini-grid support services developed under the Scaling Up Renewable Energy Program (SREP) create an opportunity to foster learning and experimentation around PUE. However, there may be a need to create other spaces for learning, including for those involved in off-grid energy and grid-extension.

1 Introduction

Policymakers and citizens often have high expectations that rural electrification programmes will transform local economies, but the global evidence tells a different story. According to a review by the World Bank's Energy Sector Management Assistance Programme,[1] rural electrification often fails to have a long-lasting or transformative impact on poor people's livelihoods (ESMAP, 2008). Why is this? One of the key reasons given is that the energy sector is focused on supplying connections and kilowatt hours, rather than aiming to impact on rural customers' revenue-generating activities. Many reviews on the topic conclude that productive activities do not happen spontaneously and additional interventions are needed to convert customers' access to the supply of energy into a thriving enterprise or new job (Fishbein, 2003; ESMAP, 2008; Finucane *et al.*, 2012; Barnes, 2014; Attigah *et al.*, 2015).

But what are these 'additional interventions' and what does it mean for Tanzania's plans to achieve sustainable energy services for everyone?

The Government of Tanzania has set targets to achieve 50 per cent electrification by 2020 and 75 per cent by 2035, and has put in place strong foundations for this. These include the existence of the Rural Energy Agency (REA) to co-ordinate programmes; a Rural Energy Fund (REF) to generate the necessary funds; and a regulatory framework designed to encourage private sector developers (IED, 2013). The National Electrification Prospectus identifies priority areas for electrification (principally via grid extension) based on criteria such as the presence of local businesses, which could help to maximise the development benefits of electrification (IED, 2013). Tanzanian researchers have previously identified key opportunities for electrification to spur improvements in rural development, particularly for milling, irrigation and small businesses, as well as creating jobs for electrical technicians (Mwakapugi *et al.*, 2010).

These foundations are critical, but catalysing jobs and livelihoods through energy investments remains challenging, particularly in poorer and more remote areas.

There are good practice recommendations on how to stimulate productive energy use (PUE), though globally there are few mature examples of successful programmes and much of the innovation is going on 'under the radar'. Also, stakeholders often have different perspectives on what is needed. For instance, research with solar start-ups in Kenya found the private sector is more likely to expect PUE to happen automatically through effective targeting of their customer base, while non-governmental organisations (NGOs) and hybrid corporate-NGO projects argue that extra support measures (training, finance) are needed, particularly to reach poorer customers (Best, 2016).

As Tanzania scales up its energy access investments, this is a good opportunity to help identify what the priority interventions should be for promoting PUE, who needs to do what, and what interventions might be appropriate for different types of service models, technologies and contexts.

[1] See https://www.esmap.org

This research focuses on decentralised energy, and specifically mini-grids, for a number of reasons:

1. Grid extension is often too expensive for many low-populated and remote areas which lack energy access and are in need of economic development. Of the decentralised options available, mini-grids provide a higher level of power than many standalone systems (like a solar home system), and are therefore better suited to many unmet productive energy needs in rural areas, such as agro-processing, carpentry, welding or computer use.
2. Tanzania is currently investing in expanding mini-grids, supported by the development partners. Key reforms include the feed-in tariff mechanism which allows independent power producers to set up small power plants and sell to the national energy provider, Tanzania Energy Supply Company Limited (TANESCO)[2]. They also include new support facilities to build the project developers' capacity and the project pipeline, for instance the green mini-grids facility from the UK Department for International Development and Swedish International Development Cooperation Agency, and the mini-grid advisory service provided by IFC-SREP.[3]
3. Mini-grid developers themselves have a keen interest in understanding how demand for productive energy use can be catalysed; as their customers' earnings and demand for power increases, so does the economic viability of their energy service. Also, Tanzania's 2008 Electricity Act states that all rural generation licensees with a capacity over 1 megawatt are obliged to supply local communities in the vicinity of their plant, which creates an additional incentive for developers to work out how to build demand locally (IED, 2013).

The research is based on interviews with Tanzanian stakeholders and field visits to hydro projects run by the European Committee for Training and Agriculture (CEFA) and the ACRA Foundation in the Njombe region, and JUMEME's solar-diesel mini-grid in Ukerewe district. The CEFA and ACRA case studies were selected for their experience in stimulating PUE, ability to demonstrate impacts, the similarity of their local contexts and their readiness to engage with the research. JUMEME provides a useful comparator, as a private company facing similar challenges but in a different region, and as a more recent start-up. In future research, the Energy Lab would be interested to compare these with other models (NGO, public, private), and with other types of energy service and technology, such as standalone equipment. Annexes 1 and 2 provide information on interviewees and key research questions.

The research is an initiative of the Energy Change lab (www.energychangelab.org). The Energy Change Lab aims to enable committed pioneers in and outside the energy sector to generate new thinking, to explore complex ideas and to develop innovative solutions in the energy domain, using a mixture of research, experimentation and practice. Energy and jobs is a priority theme identified in our consultation with stakeholders in Tanzania. We are building on this research to help design a productive use of energy action-learning programme, which aims to support developers and non-energy stakeholders design and test PUE assessment and support measures, and share these learnings across the sector. We are interested to discuss with others how we might collaborate on finding practical solutions.

[2] Outcomes of the off-grid component of the World Bank-supported Tanzania Energy Development and Access Project have included TANESCO signing standardised power purchase agreements with 11 developers to supply 46MW of power; and TANESCO signing letters of intent with another 6 developers for 31MW of power, with four small power producers already in operation. The REA is processing additional grant co-funding to prepare 60 mini-grid projects and standalone solar projects to benefit many more consumers (AfDB and CIF, 2015).

[3] The International Finance Corporation's Scaling-Up Renewable Energy Programing Low Income Countries – see https://www-cif.climateinvestmentfunds.org/country/tanzania. SREP activities in Tanzania include the creation of an online information portal for mini-grid developers – see http://www.minigrids.go.tz/en

2

Catalysing PUE requires special interventions and design measures

The barriers which typically inhibit people on a low income from using energy productively are well known; they are summarised in Table 1. These will of course vary according to the local context.

There is good practice guidance available on how to overcome these barriers and promote productive uses. Particularly noteworthy is the toolkit produced by the Productive Use of Energy (PRODUSE)

Table 1. Typical barriers to productive uses of energy

DEMAND SIDE	SUPPLY SIDE
• Lack of knowledge by small and micro-businesses, households and farmers on how to use electrical and motive power for profitable enterprise • Users' low technical, business or management capacity to run a viable business activity • Local people's low or fluctuating incomes, and lack of finance to pay for energy services or equipment • Poor access to markets for the new products/ services enabled by energy, eg poor roads, lack of access to related inputs • Social inequalities which limit opportunities for poor or vulnerable groups (eg women)	• Poor understanding by energy providers of rural markets and customer base • Energy providers' service is based on least-cost supply, rather than delivering development benefits for customers • Insufficient co-ordination of energy with complementary services, eg agricultural extension services, transport, water supply and microfinance institutions • Poor service quality which inhibits take-up, eg interruptions, voltage drops or blackouts • Constraints in the wider enabling environment, eg lack of affordable financing or policy incentives to invest in decentralised energy

initiative on electrification (Brüderle *et al.*, 2011).[4] The recommended interventions highlighted in the literature fall into three main areas:

- Undertake PUE assessments and planning at design stage
- Conduct promotional and support activities with communities and customers
- Improve the wider enabling environment.

Another framework is the 'energy delivery model' approach (Bellanca and Garside, 2013) which helps local stakeholders think through different income-generating ideas. This approach uses a participatory process of dialogue and action-focused research to identify delivery models which are workable and sustainable in a particular local context. Table 2 below gives specific examples of what these interventions might entail, and this framework will be used to analyse the case studies.

Table 2. Nine ways to address barriers to PUE: lessons from good practice guidance

NO.	GOOD PRACTICE AREA	EXAMPLE ACTIVITY
Assessments and planning		
1	Assessment to understand PUE opportunities in target area	Supplement feasibility assessment on demand and willingness-to-pay with in-depth analysis on PUE applications, constraints and opportunities
2	Select sites on basis of untapped opportunities and enabling conditions	Use criteria such as existence of infrastructure, complementary investments, support services, and entrepreneurship levels to select site
3	Link up with complementary services, sectors and programmes	Link up with large-scale projects, eg agriculture investment, and identify actors who can help on PUE promotion, like business associations
Promotional activities with communities and customers		
4	Build community awareness and involvement from an early stage	Stretches from basic information provision (on PUE opportunity, appliances, cost of service) to deep engagement with local community to work out how to align energy with local development ambitions
5	Facilitate training for enterprise development and other technical skills	Targeted at farmers, micro, small and medium enterprises with potential for value addition. Could cover areas such as financial literacy, business management, selecting end-use equipment
6	Facilitate access to finance	Foster relations with banks, micro-finance institutions, saving cooperatives to identify suitable loan products to finance energy products, appliances or related investments
7	Promote standalone energy technologies and end-use appliances	Improve availability of end-use appliances (computers, refrigerators), eg by establishing specific fund or loan products, or encouraging energy providers/local shops to offer these
The enabling environment		
8	Address policy and institutional constraints for energy technologies and their take-up	Wide-ranging, but covers areas such as economic and regulatory incentives for energy providers (pricing, subsidies, tariffs, permitting, duties, donor finance) and for end-use sector (eg agriculture extension services, incentives for rural banks to lend to farmers)
9	Widen targets and indicators to include PUE impacts	Funders (public funders, international development partners and social impact investors) set PUE as a condition of financing energy providers and invest in measuring PUE outcomes

Source: Best, 2016.

[4] See www.produse.org. PRODUSE is a joint initiative of the Energy Sector Management Assistance Program, the Africa Electrification Initiative, the EU Energy Initiative Partnership Dialogue Facility and the German Society for International Co-operation.

3

Introducing CEFA and ACRA case studies

3.1 ACRA: Access to power through Mawengi and Lugarawa mini-grids

The ACRA Foundation is an Italian non-governmental organisation that has worked in Tanzania since 2006, in collaboration with the local government in Njombe, the Njombe Development Office and the Njombe Catholic Church's development arm, to deliver the Mawengi Integrated Rural Development Program. The centrepiece is a 300-kilowatt run-of-the-river system[5] and isolated mini-grid[6] which supplies power to nine villages. This is now being followed with a much larger 1.7-megawatt system (Lugarawa project) which will feed into the grid and serve 20 villages.

Some important elements of the Mawengi and Lugarawa delivery model are the goals, participatory approach and management structure. The prime aim is to maximise the benefits of energy access for users as well as ensure the sustainability of the service. The programme uses extensive multi-stakeholder participation to engage the communities, and has an integrated approach in the sense that it combines affordable power provision with wider socioeconomic development and environmental management. ACRA emphasises that it follows a programmatic approach guided by a long-term vision and outreach, rather than a project-by-project approach. Because of its belief that local participation is key to sustainability, ACRA wanted the hydropower plant to be owned by the communities and established a community-based utility, LUMAMA, for that purpose. The manager, accountant and technicians have been recruited locally and the NGO conducted extensive capacity building so that LUMAMA staff have the skills to manage the system on a daily basis.

The projects are funded through grant capital from a mixture of funders, including the European Commission, the Italian Ministry of Foreign Affairs and Tanzania's Rural Energy Agency. From 2015, LUMAMA was able to generate sufficient revenues to cover the entire operational and maintenance costs, and it aims to cover 100 per cent of depreciation costs by 2020. The key features of Mawengi and Lugarawa are summarised in Annex 3. For an explanation of the community involvement, economic viability and the links between the two, see Ahlborg and Sjöstedt (2015).

[5] Run-of-the-river hydroelectricity is a type of hydroelectric generation plant where there is little or no water storage (in the form of a reservoir). Running water is diverted from a river and guided down a channel which leads to a generating house. The force of the moving water spins a turbine, which then drives a generator.

[6] An isolated mini-grid involves small-scale electricity generation which serves consumers via a distribution grid that can operate in isolation from national electricity transmission networks.

Miko Andrea Haule, Mawengi

Miko runs a small workshop, using power he buys from LUMAMA. He uses the extra income earned to pay for school fees.

Credit: IIED

3.2 CEFA: Access to power through Matembwe and Ikondo mini-grids

The European Committee for Training and Agriculture (CEFA) is an Italian NGO that has operated in Tanzania since 1976 in the areas of rural electrification, water supply, agriculture and agro-processing. The organisation has established three mini-hydro power plants (Matembwe, Bomalong'ombe, Ikondo) which provide electricity for people living in the Iringa and Njombe regions. CEFA's philosophical outlook also places a strong emphasis on stakeholder engagement, community ownership and integrated rural development. Its approach has influenced other not-for-profit hydro projects in the region, including ACRA.

The Matembwe plant was constructed in the 1980s by CEFA and is now run by the Matembwe Village Company (MVC Ltd). MVC is an integrated company which runs the power project and other agro-processing businesses. MVC employes 26 staff and has five shareholders: the Catholic Church, the district of Njombe, the village of Matembwe, MVC employees and the Ikondo Village Council. CEFA has been gradually withdrawing over ten years and in 2014 withdrew its shareholder stake, which was redistributed to MVC. At the same time MVC was turned into an employee co-operative and Ikondo Village Council was added as a shareholder (because MVC is managing the new Ikondo II project). The capital costs for CEFA-initiated hydro plants are grant-funded. Further information on the projects we visited are in Annex 4.

CEFA is currently upgrading the Ikondo project, Ikondo II, and working to develop two much larger projects, Ninga and Luganga, which they intend to run as 'non-profit/for profit partnerships' in collaboration with the private sector. Both are proposed as run-of-the river schemes which would have TANESCO as an anchor client. The driver for a new model is that hydropower requires significant capital investment, yet public budgets do not cover these costs and international donors are shifting from grant to loan capital in order to attract more private sector investment into the sector. The partnership approach proposed by CEFA aims to combine private sector capital (allowing cost recovery/profit for the private actor), with NGOs' social objectives to deliver energy access to local communities and support local empowerment processes (Pendezza, 2014).

4

What types of PUE needs are targeted and what are the barriers?

The main economic activity for communities is agriculture, with people producing maize and beans, as well as wheat, coffee and some fruits and vegetables. People grow crops for their own consumption (maize) or to sell into local markets, with coffee sold further afield for processing. Njombe region is a centre for timber production. Like most rural areas, large parts of the economy (excluding timber) are seasonal, which affects the ability of people to use and pay for electricity. Matembwe has a more vibrant and diversified local economy than a very remote community like Ikondo, and this appears to be linked to the long-standing power project (see Section 6 on impacts).

For CEFA and ACRA, the main productive activities targeted are food production, agro-processing, agro-forestry and the local service sector.

The background to the Matembwe (CEFA) power project is particularly interesting because it started not as an energy project, but as a livelihoods and food security project. There was a problem locally with human nutrition: people cultivated the land but did not have animals, and as a result their protein intake was low. In consultation with local stakeholders, CEFA decided to establish a poultry farm to produce chicks to sell to community members, who could in turn rear chickens and produce eggs. CEFA also provided various types of agricultural training and support. The power project only came about when it was identified that the poultry farm needed electricity for the incubators, and this eventually evolved into an energy service to supply households too. This holistic approach, whereby the project was driven by the end-use demand (food security) is different to more conventional supply-driven approaches.

It is important to note that the NGOs and the community utilities they established have been as interested in household and service sector use as they are in productive activities. This includes lighting for houses, pumping drinking water and lighting schools and health clinics.

The types of barriers to people using energy productively are familiar and align well with those listed in Table 1. Interviewees particularly mentioned problems around awareness, knowledge and finance. They explained that local people often do not know about market opportunities they could exploit with the benefit of electrical power, or the basics in business management. And while some people do have financial resources (from farming, family loans, or existing businesses) to start new business activities, others do not.

Animal feed factory, Matembwe

As well as supplying power, the Matembwe Village Company Ltd runs an animal feed factory supplying 250 tonnes of animal feed per year

Credit: Sarah Best

5

What types of PUE interventions do CEFA, ACRA and their partners use?

This section reviews what CEFA and ACRA and their partners have done to promote the productive use of electricity, as part of the early assessment phase and through additional support activities. Questions around the enabling environment are picked up in Section 7.

5.1 Assessments and planning

The first area of intervention recommended in good practice guides is that project developers or their partners conduct a thorough **assessment of the PUE potential** in the early design stages. This is more than a feasibility assessment (which examines local demand and willingness to pay to ascertain the economic viability of the service for the energy provider). A PUE analysis would focus on assessing potential outcomes for users and on pinpointing exactly which user groups and activities are best to target, given the objectives of a project and likely budget constraints. An analysis could include:

- Identifying relevant value chains, based on local demand and priorities, that local producers supply or could supply into – including a breakdown by gender goals and possible outcomes
- Evaluating the role of energy inputs versus other bottlenecks to productivity and value addition (transport infrastructure, regulatory barriers, access to finance, and so on)
- Likely cost-benefits to customers of investing in new energy services and equipment (production volumes and costs, consumer prices, employment creation/ destruction, incomes).

The impression from our research is that CEFA, ACRA and their partners have done some baseline surveys but not gone as far as an extensive PUE assessment as described above. In the case of Mawengi, ACRA did work with a consultant to identify possible new business options; while CEFA drew on its existing local knowledge and relationships to identify needs and opportunities.

However, interviewees did see the value of more in-depth PUE assessments and are starting to carry these out. For instance, for the new projects CEFA is developing, they have used matching grants from the Energy and Environment Partnership[7] to do a socioeconomic assessment baseline, which could help pinpoint opportunities and be used to review impacts later on. ACRA is planning to conduct market research and prepare a participatory business plan for small local businesses as part of the new Lugarawa project, as well as provide training and financial support for local enterprises.

The good practice guidance also emphasises the importance of **selecting sites** on the basis of PUE potential, meaning aspects such as the presence of potential anchor clients, an existing entrepreneurial local culture or a higher-level investment programme led by another agency that an energy service could co-ordinate with (for example in agriculture development). These relate to better understanding aspects of the energy delivery model itself – such as the user base and potential forms of revenue – as well as the wider enabling environment for issues of regulation and access to finance. It is also important to understand the sociocultural aspects of a particular context, as these impact the way stakeholders will respond to, and engage with, proposed PUE interventions.

In the projects reviewed, the NGOs and their partners have selected the sites based on an identified need for power to resolve a local development problem, the organisations' existing commitment to that geographic area and technical considerations around the suitability of the hydro resource. Aspects such as the prior existence of entrepreneurship (ready to use the power) or a complementary, higher-level investment, which are a key element of good practice guidance, do not appear to have been present. This suggests the social mission of the NGOs to reduce poverty is a more important factor in selecting the sites.

5.2 Promotional and support activities with customers and communities

CEFA and ACRA, as well as the community utilities they helped establish, are doing various types of promotional work. An approach they all have in common is to provide a 'demonstration effect'. The organisations have invested some grant funding into supporting or setting up from scratch a few local businesses that use electricity. Interviewees described this as a way to show local people what might be possible – then leaving it largely to people's private initiative to develop and build business opportunities of their own. Another similarity is the long-term presence or commitment of the NGOs, and the wider community, agricultural and environmental work they do. This all creates the possibility for the type of joined-up thinking needed for rural development processes, which an energy developer on its own might struggle to do. Below we describe some of the key measures that have been used.

5.2.1 Building community awareness and involvement from an early stage

The CEFA and ACRA projects have worked extensively towards community awareness-raising and mobilisation on a wide range of issues related to the power projects. While PUE is one of several information topics, it seems likely that the broad range of community engagement and skills building is starting the process of people learning how energy could be used to support their livelihoods. Engagements include:

- **Preparing the community:** explaining what the energy service is and what people need to do to get connected (costs, housing upgrades)
- **Managing environmental and safety issues**: for instance, explaining rules on land use or fire risks to electricity poles
- **Involving users in utility governance**: both MVC and LUMAMA have a series of community energy committees to share information and discuss key issues, such as on tariff rates (see Annexes 3 and 4 on user involvement)
- **Providing information on PUE opportunities:** for example, ACRA sponsored community members to attend the Nane Nane agricultural exhibition where they learned about end-use equipment (such as oil presses).

[7] See http://eepafrica.org/portfolio-item/tan9043/

5.2.2 Promoting business start-ups and end-use equipment through funding and showcasing

The most interesting feature of the CEFA and ACRA approaches is that they have chosen to establish or fund new enterprises which use the electricity, rather than just provide training. This is done in a number of different ways:

- **Establishing new, utility-owned enterprises.** The example of Matembwe Village Company (MVC), which was established by CEFA, is particularly unusual as it has been set up as a company with diverse activities; as well as selling power, it runs a poultry farm and an animal feed factory. About 30 per cent of MVC power is consumed by MVC-owned businesses and – while our research did not do a financial analysis – the income from non-power businesses appeared to be critical for the viability of MVC Ltd. These businesses are operating at some scale: the animal feed factory, which buys raw materials from local farmers, is selling approximately 250 tonnes per year, and the poultry farm sells 200,000 chicks per year to customers all over the southern highlands. In Ikondo, CEFA has also set up some co-operatives which are using the power, such as a carpentry workshop, although these co-operatives are separate from the power provider (currently run by CEFA and being transferred to MVC).
- **Funding new enterprises and end-use equipment.** LUMAMA (established by ACRA) takes a slightly different approach to MVC since it focuses on selling power alone. However, ACRA has provided LUMAMA with financial support to enable some local people to purchase equipment for use in new entrepreneurial activities. A grant fund of 4 million Tanzanian shillings (TZS; about US$1,800) was established for this purpose. There is a formal process to apply for funds and criteria for selection, for instance based on expected employment creation. ACRA funds are used to pay for 75 per cent of the equipment costs with users contributing 25 per cent. This has been used by individuals to purchase, for example, an oil-seed pressing machine, fruit-juice maker, sewing machines and an egg incubator. About 20 local enterprises have been supported in this way. A review by Ahlborg and Sjöstedt (2015) found that almost 30 per cent of all LUMAMA's customers are using electricity for business, accounting for 58 per cent of the electricity sold.
- **Electricity purchase rights to incentivise low-price milling.** Milling services are a top priority for the community. LUMAMA operates a soft regulatory tool, whereby the utility allows a local miller to buy LUMAMA electricity in exchange for a commitment to sell electric milling services at a lower price than the diesel mills.[8] The intention is to make milling affordable for local families who depend on maize (*ugali*) for basic sustenance. The number of electric milling rights issued are restricted to 1-2 per transformer,[9] since milling consumes a lot of power and the system cannot support more. The process is that the business person who wants to invest in an electric mill applies to the chair of the local transformer committee, who decides whether or not to award the electric milling right. LUMAMA and ACRA advised on the purchase of the equipment and subsidised 50 per cent of the installation costs; however, the milling machine owner pays for the rest of the capital investment (Ahlborg and Sjöstedt, 2015). One miller we spoke to, who had previously run a diesel mill with her husband, explained that their business is profitable – even despite the price cap – because of the cheaper costs compared to diesel power.
- **Capacity building and skills development.** The good practice literature often recommends training in business literacy, for instance helping people with basic accountancy skills or with marketing their products. While CEFA and ACRA do invest in capacity building, there was no formal 'enterprise development' training programme at the time of the initial projects. What we did observe is that some of the individuals who used power for productive activities were involved in other (non-power) projects of the two NGOs. For instance, a carpenter in Ikondo had previously worked as a trainer in CEFA's carpentry workshop, and when power came to the community he decided to establish his own carpentry business, securing a grant from the local savings and credit co-operative organisation (SACCO) to buy machinery. This hints at a fairly organic process of individuals getting exposed to new ideas, gaining confidence and skills, and gathering financial resources. ACRA have since established a vocational training school in Njombe aimed at enhancing entrepreneurial skills; it also sees scope to enhance on-the-job training.

[8] Research conducted in 2012-13 by Ahlborg and Sjöstedt (2015) found the price for milling services was halved, and this is reported by ACRA (undated). However, at the time of this research in September 2015 interviewees reported a cost of TZS1,800 per 20 litres from the electric mills versus TZS2,000 per 20 litres from diesel mills – only a 10% price difference. The research did not identify the reasons for this difference.

[9] A transformer is a static device used for transforming power from one circuit to another without changing frequency. It reduces the high voltage electricity from power plants to the lower voltage electricity used by households and businesses. The governance of LUMAMA has three tiers, the highest level being the General Assembly, followed by zonal- and transformer-level committees.

- **Supporting agricultural livelihoods for environmental conservation and community buy-in.** ACRA provides a final example of livelihood support: it has trained groups of local farmers in sustainable agriculture, forestry and keeping livestock as a way to diversify local agriculture, as well as encouraging the production of crops identified as having commercial potential (eg avocados, sunflowers, coffee, pyrethrum). Hydropower can have significant environmental impacts and projects are required by law to restrict people from cultivating land or withdrawing water (for irrigation) in order to protect the hydro resources that feed the system. The livelihood training is thus less about productive *energy* use and more geared toward wider local development – building local support for the project; compensating for disruptions; and ensuring good environmental management of natural resources at the watershed level. ACRA have also established reforestation activities on land at risk of erosion in the catchment basin, and provided electricity services to the villages upstream as an incentive to preserve natural resources.

5.2.3 Addressing affordability barriers and improving access to finance

The projects have so far addressed the affordability challenge principally **by providing cheap power,** as well as awarding **some grants for new business starts-ups** (described above). LUMAMA, MVC and CEFA have been able to sell energy at tariffs lower than the national tariff, since 100 per cent of the capital investment has been supported by grant donations, and because they are not-for-profit entities. Equipment replacement and technical support has also been supported through grants and voluntary support from Italian engineers. One carpenter in Ikondo interviewed for this research explained how cheap power was a crucial factor in the profitability of his business.

The tariff strategy will change with the bigger types of projects, feeding into the grid, that CEFA and ACRA want to develop. For instance, CEFA staff explained that they are raising tariffs to TANESCO rates so that local households and businesses are attractive customers for private sector partners. The advantage of feeding into the grid is that all the power produced can be sold, whereas with an isolated grid this is not the case.

Several small business customers have **drawn on their own financial resources,** such as farming incomes, to buy equipment or expand their businesses. A LUMAMA customer and carpenter we spoke to in Mawengi had used his ownership of a small tree plantation as collateral to get a bank loan to buy electrical equipment; while a local welder had been gifted his equipment from a church patron. In Msanyo, a village which is preparing for connection to the Lugawara project (under ACRA) in 2017/18, community leaders were advising local people to plant trees in order to generate resources to pay for the costs of connecting and other investments.

Two other potential avenues have been identified for helping customers with financial constraints. In Ikondo, CEFA has helped establish a SACCO group. The loans are used by households to help pay for connection costs, but it is conceivable they could be used in the future for business-related purchases. One possible limitation to this is loan size. For instance, customers of LUMAMA pointed out that the local savings group operating in that locality, VICOBA, offered quite small loan sizes – too low for buying many types of larger machinery.

Finally, LUMAMA have considered providing credit to consumers and retail businesses for starting up productive activities that make use of energy. This would be linked with their customer payment system which uses a pre-paid model, thereby allowing efficient collection of loan repayments (ACRA-CCS, 2014). This appears to still be at the ideas stage and ACRA have identified there may be some regulatory issues to consider around whether a community utility is allowed to offer credit.

6

What are the impacts?

One of the unexpected findings from our case studies was that, when asked about the most significant impacts of electrification, several interviewees emphasised household-level impacts. They particularly mentioned how people had replaced kerosene with electric lighting (reducing costs and health risks) and improved the condition of their houses because they upgraded from straw to tin roofs, an essential prerequisite for installing electrical wiring and preventing the risk of fire. Not only did this improve the quality of people's lives; interviewees felt it generated a sense of village pride. We can speculate this may also trigger people's personal ambition to improve their opportunities to earn money. It also reminds us again of the need for a holistic approach that places people's productive energy needs alongside energy needs for household and public services.

Aside from the household impacts, there were also **significant PUE impacts**; the number of business customers is evidence that many productive end-uses have been supported. For instance, LUMAMA reports having 310 business customers and 21 milling machines connected to their grid in 2014 (Ahlborg and Sjöstedt, 2015).[10] ACRA has facilitated some academic assessments of the impacts of electrification on local communities, including around business usage, such as that by Chalmers University (Ahlborg and Sjöstedt, 2015). This is helpful and, with the right funding, could go even deeper in the future to measure effects on incomes at household and enterprise-level against baseline assessments.

The **poultry farm and animal feed** factory run by MVC is particularly striking because of the scale of its operations built up over three decades. As previously mentioned, the company itself employs 26 staff, and sells 200,000 chicks and 250 tonnes of animal feed per year. There are likely to be a number of economic spillovers as a result of these businesses, for instance as local farmers and householders earn money by either selling their harvest to the animal feed factory or selling eggs and chickens sourced from MVC. One interviewee commented that Matembwe is now one of the main areas for agro-forestry in the Njombe region, with many timber yards and carpenters. Any visitor to the town will notice a lot of economic activity compared to many of the surrounding villages without electricity. Certainly there is enough demand now that TANESCO has extended its distribution lines to Matembwe and some people have two connections – retaining the cheaper MVC power, but substituting for TANESCO during power outages.

Across both the CEFA and ACRA projects, the electricity is being used in milling, tailoring, carpentry, sawmilling, juice and jam-making, mechanical workshops, local shops and businesses, welding and oil-seed pressing. For the Mawengi project, the provision of electric light has reportedly led to longer opening hours and more customers for local retail outlets, such as barbers, butchers and restaurants (Ahlborg and Sjoestedt, 2015). One NGO staff interviewee speculated that the availability of electrical power was slowing outward migration and even

[10] The ACRA website states that 59 production enterprises and 167 commercial enterprises have been connected to the LUMAMA power supply (ACRA, undated), although these lower figures may be out of date.

A carpenter in Ikondo, and former trainer at CEFA's carpentry workshop, established his own business with the arrival of power. The low cost of electricity contributes to business profitability

Credit: Sarah Best

encouraging people who had moved to the city to return to the village because of the new business possibilities.

The impact from **milling machines** is particularly important. Reduced milling prices are likely to have generated cost savings for householders and/or reduced the time and physical burden on women who are responsible for maize processing and may have previously ground it by hand or paid for (more expensive) diesel-run services. The high energy consumption of milling machines also contributes to the economic viability of the service. LUMAMA's records in 2014 show that the 21 miller customers generated more income than 600 household customers (Ahlborg and Sjoestedt, 2015).

There are also a number of uncertainties or limitations in terms of PUE impacts. For instance, MVC faces major problems with power outages, mainly because of the lack of water during the dry season to run the turbines; this is a critical challenge for business customers who need a reliable supply. The impact on employment is not clear – research on LUMAMA found that some shopkeepers had taken on new staff, while in other cases, such as carpentry workshops, the introduction of electrical equipment may have reduced their workforce. The gender equality impacts are also uncertain. On the positive side, the NGOs and community utilities have made efforts to include representation of women in the user group committees; women are said to benefit from many of the household and public service impacts; and a few of the enterprises supported are run by women. However, in general, we identified that no specific strategy was adopted to promote women entrepreneurship and it is possible that because of existing social inequalities, men have more opportunities than women.

Esther is a farmer and ex-nurse living in Milo. ACRA supported her to buy an oil press, turning sunflower seeds into cooking oil and waste into pig feed. Customers bring the raw material and usually consume the end products themselves. The total investment was about TZS3.5 million for machinery (paid for by the ACRA grant and a family loan), TZS200,000 for the wiring and TZS1 million in building costs.

Variable sunflower production locally means Esther is considering planting seeds herself to ensure a reliable supply.

Credit: Sarah Best

Local businesses' success and productivity is held back because of barriers that are unrelated to the availability of electricity or related equipment. For instance, a juice-making business supported by ACRA failed to achieve its ambitions to sell juice outside the locality due to a lack of investment and certification to meet food hygiene standards (managed by the Tanzanian Bureau of Standards). A new oilseed pressing business had done well in the first year, but was affected at the time of the research by a fall in local sunflower production (see the photo of the farmer with her oil press, and its caption). Equally, some carpenters have increased their speed of production, but local prices reportedly remain the same, and poor quality raw materials make it difficult to sell to markets further afield (Ahlborg and Sjoestedt, 2015). Poor road infrastructure, the seasonality of demand and lack of investment capital remain important barriers (Ahlborg and Sjoestedt, 2015).

In summary, CEFA and ACRA have experimented with several, but not all, of the PUE interventions recommended in good practice guidance. While their assessments on productive energy use opportunities were not in-depth, CEFA and ACRA have made efforts to raise awareness and support specific enterprises. We have also seen how they have tested approaches which are not on the typical PUE support checklist. These include:

- **Low tariffs enabled by extensive grant finance,** which helps with affordability, but makes cost-recovery more of a challenge
- An energy delivery model based on **community participation and a co-governance** role, eg through user committees, local employees, allocation of milling 'rights'
- **Tailoring to the local context** and fitting energy into a **wider project of agricultural and community development**, as well as environmental protection.

Concluding remarks

The projects have had significant social and economic impacts, though future investments would benefit greatly from tracking these impacts in a more systematic way. The design of the CEFA and ACRA energy projects are inspired by the NGOs' overall approach to development based on promoting self-reliance, community participation and integrated rural development. This participatory, bottom-up approach appears distinct to some strands of today's energy debate which see the leveraging of private sector investment and market-based solutions as the key to poor people's lack of energy access. Globally, the emphasis in today's planning remains predominantly on the supply of energy and more rarely adopts the holistic thinking on development outcomes that we see in these two cases.

The third case study, JUMEME Rural Power Supply Ltd, provides an opportunity to look at how a privately run energy developer which has only recently started operations tackles the challenges of energy and productive use in a very different local context – fishing communities in Lake Victoria.

7

JUMEME Rural Power Supply

7.1 Introducing JUMEME

JUMEME Rural Power Supply Ltd is a joint venture owned by the German energy solar mini-grid engineering and consultancy firm INENSUS, the St. Augustine University of Tanzania, and two Austrian renewable energy project developers, Terraproject and RP Global. The project is advised by Energy 4 Impact (formerly known as GVEP), which supports businesses supplying off-grid energy access; Excel Hort Consult, a Ugandan agricultural consulting firm; and the Sustainable Business Institute.

JUMEME is running a US$17 million (€16 million) solar-diesel hybrid mini-grid project targeting islands in Tanzania's lake region. The project started in 2014 and aims to provide access to electricity for over 80,000 people by 2018, building mini-grids across approximately 16 rural towns and villages. As well as supplying households and community services, the firm aims to create 500 new businesses using energy for productive purposes, particularly in the agri-food sector (JUMEME and EU, 2015).[11] The project financing involves a mixture of grants and private finance. A European Union (EU) grant covers 46 per cent of project costs with the remainder made up of private finance and smaller grants for project development and technical assistance.

JUMEME aims to become a sustainable and profitable electricity company. One interviewee estimated that the project could be self-sustaining in three to five years; another suggested that JUMEME operates more like a social enterprise, referencing the grant capital and socially oriented objectives.

INENSUS describes the JUMEME model as involving "a combination of community-oriented governance, modular capacity planning, smart meters for demand and load management, as well as a tariff block structure".[12] It labels this a "micro-power economy business model" (INENSUS, 2016).

[11] See https://www.scribd.com/doc/307082601/Jumeme-Project-Fact-Sheet

[12] Ibid.

Construction of the JUMEME solar-diesel mini-grid in Ukara Island

Credit: INENSUS

Community involvement is via a village power committee which acts as an interface between the company and local people – sharing information with customers on key issues, accompanying JUMEME staff to meetings locally and bringing complaints to managers' attention. The modular approach allows the company to gradually increase the system size as demand grows. The tariffs vary according to the type of customer. More information on the approach to tariff-setting is detailed in Box 1, and on the delivery model in Annex 5.

This case study is based on findings from a short field visit by the researchers to the pilot site on Ukara Island. Ukara is located in Ukerewe district, north east of Mwanza, and has around 37,000 inhabitants. The pilot project is located in Bwisya Village, which is the main village in Ukara Island.

The pilot was launched in April 2016. At the time of the visit in May 2016, 103 customers in Bwisya were connected, with plans underway to connect up to 250 domestic and business clients in total. JUMEME have also established a shop in Bwisya that sells a variety of electrical equipment such as televisions, radios, stereos, rice-cookers and popcorn-making machines.

Phase 1 of the pilot includes a mini-grid of 7-kilometre 230/400 volt low-voltage lines, a 60 kilowatt peak (kWp) photovoltaic system, a 240 kilowatt hour (kWh) battery bank, 54kW bidirectional battery inverters and a 33 kilovolt amps (kVA) diesel generator. At the time of the visit, the developers were planning a second phase to increase the power station capacity to 380kWh and add a medium voltage line to connect six of the seven other villages on Ukara Island (AfDB, 2016).

BOX 1. JUMEME'S APPROACH TO TARIFF SETTING

Initially JUMEME is able to set the tariff without regulatory approval, though once the system is above 100 kilowatts the rates have to be approved by the regulator, EWURA.

The tariff rates are set following a demand assessment, which involves consulting potential users on the service options and their costs, asking them what type of service they want and can afford. Prices and payment systems are designed to be competitive with conventional energy options.

The company offers variable rates depending on whether the customer is a household, commercial (small shop) or industrial customer (miller), and on the time of day that electricity is used. It sets lower business charges during the day. This helps to smooth usage, encourages people to use electricity when the solar PV is producing at a low cost, and minimises the risk that the system becomes overloaded in the evenings when people use electricity in their homes.

In late 2016, the company was in the process of introducing technologies to enable payment using mobile phone money transfer platforms.

JUMEME's mini-grid tariffs appear to be more expensive than the state utility TANESCO. However, the company emphasises that taking into account all the tariff components and the other services provided by them to the customer, then JUMEME's mini-grid tariffs are competitive. It points out that JUMEME does not charge the high connection fees that makes a TANESCO service unaffordable for many rural customers, but instead absorbs these costs into the tariff (Peterschmidt, undated).

7.2 What PUE opportunities exist and how are these assessed?

The main productive use of energy opportunities in Ukara lie first in providing electricity for lighting and machine use in existing local services, such as small grocery shops, the miller or barber shops. Many of these are low-power activities, with the exception of milling, bakery, wood and metal workshops. The second type of opportunity lies in the fishing (nile perch, tilapia, *dagaa*[13]) and agriculture sectors (cassava, sweet potatoes, rice), which represent the major sources of income for people living and working on the island. The barriers to stimulating PUE are typical for a rural economy; they include remoteness, poverty and a lack of transport links, access to finance, business skills and knowledge of business opportunities (enabled by energy).

Identifying and targeting productive energy use is a major priority for JUMEME. The big risk for JUMEME is if customer demand is lower than expected or hoped for. The company has a three-step strategy for mitigating this risk:

- Assessing demand
- Fostering demand for PUE through promotional and support activities with customers
- Managing demand through technology, pricing and information mechanisms (INENSUS, 2016).

The remainder of this case study examines the first of these two interventions. The third element of demand management element includes interventions such as lower daytime tariffs for productive use customers and testing mobile money platforms to make payment collection more efficient.

7.2.1 PUE assessments and planning

JUMEME conducts initial demand assessments to determine tariff levels, but has also partnered with the advisory organisations Energy 4 Impact and Excel Hort to carry out more in-depth economic assessments of PUE potential and provide training for villagers. Box 2 summarises how JUMEME's owners see a division of roles between the company and its partners when it comes to PUE promotion.

BOX 2. ASSESSING AND PROMOTING PUE: ROLE OF THE ENERGY PROVIDER AND PARTNERS

For JUMEME, the core role of the utility is to support PUE assessment and awareness-raising work, in order to understand their customers; design a viable tariff; and help select electrical equipment that works with the power supply system. JUMEME also plays a short-term (6-12 months) role in pre-financing customer equipment on a short-term basis, liaising with local banks, SACCOs and microfinance institutions.

They view the role of NGOs and consultants (such as Energy 4 Impact and Excel Hort) as focusing on enterprise training; generating business ideas; research; and forming farmer groups and savings groups that could be future PUE customers.

A key challenge for JUMEME is that significant time and money goes into co-ordinating partners, with the risk that the co-ordination costs are higher than the value of a specific PUE project. JUMEME is exploring a 'one stop shop' approach to streamline and co-ordinate PUE support activities.

JUMEME and its partners conduct two types of PUE assessment:

- **Existing business – micro-enterprises:** Energy 4 Impact conducts assessments on the opportunity-costs of electrification for specific enterprises, which are typically very small businesses. In one example, the team did an assessment for a bakery switching from firewood to electricity to power its ovens. This covered aspects such as costs (energy, new equipment, transportation), production impacts and market demand. The assessment took five days of an adviser's time to gather the relevant information and source the equipment; a similar exercise for the miller (switching from diesel to electric) took three days.
- **Future business – larger investors:** In the second type of assessment, JUMEME and its partners look at future market opportunities on a larger scale. This focuses on understanding local resources and conditions and identifying productive energy uses that could work well with JUMEME's electricity services. The assessments have been used to develop an investment prospectus aimed at attracting inward investment from the mainland (Energy 4 Impact *et al.*, 2016).

[13] *Dagaa* is the Tanzanian name for the silver cyprinid found in Lake Victoria.

JUMEME's approach is to attract PUE investors into the area by providing the offer of reliable electricity and providing some initial data on those economic opportunities. The project has identified 13 broad investment areas,[14] ranging from water supply to fish drying and poultry farming. For instance, Ukara has good soil quality and access to water, and villagers have a basic knowledge of rice farming. With the addition of electricity, water pumping and storage, there is an opportunity for smallholder farmers to start rice irrigation.[15]

Some of this sub-sector analysis for the investment prospectus appears fairly in-depth, involving for example soil testing to determine what high-value crops could be grown and processed locally. Others are more high-level estimates covering aspects such as land and transportation costs, the availability of raw material and levels of production, and identifying buyers. A short review by Contejean and Verin (in press) of the ice-making and fish drying prospects recommend that a deeper analysis and small-scale piloting could help build a better understanding of local demand, willingness to pay, the economic viability of a proposed new business, and development impacts (see Box 3). From the perspective of JUMEME owners, however, it is not feasible as a private sector company to bear the cost of such piloting.

7.3 PUE promotional and support activities

The main promotional activities run by JUMEME and its partners include: awareness-raising; supporting existing micro-enterprises through business plans and enabling access to finance; attracting inward investment; and providing support to primary production and women's groups.

7.3.1 Awareness-raising

Like CEFA and ACRA, JUMEME has worked extensively on community awareness-raising from an early stage. However, in Ukara awareness-raising is done by the village power committee, which is essentially an information and liaison forum to engage with JUMEME as a privately run utility. This contrasts with MVC and LUMUMA, where the committee structure gives residents a more formal role in overseeing operations of a community-owned utility.

One interviewee noted that having St Augustine University as a JUMEME shareholder has been important for building relationships, because the university is known and trusted by local people.

BOX 3. ELECTRICITY FOR ICE-MAKING IN UKARA

Establishing ice-production facilities on the island could potentially reduce local cool-box owners' dependency on the fish traders (or middlemen), who provide ice as part of their payment for fish. It could also reduce fish losses, since those middlemen often lack sufficient ice to keep all the fish chilled before they reach processing factories in Mwanza.

However, Contejean and Verin point out that the market among different customers on Ukara is not fully quantified, as it covers not just cool-box owners, but also butchers and those preparing fresh juice.

The knock-on effects on the value chain also merits further scrutiny: for instance, middlemen may resist the changes, given they currently receive free ice from the factories.

One of the big challenges is gathering robust and consistent data in areas such as fish catch sizes. Filling these data gaps supports investment decisions but add time, cost and complexity to PUE assessments.

Source: Contejean and Verin (in press).

[14] 1) Agriculture/horticulture; 2) water supply for irrigation; 3) *dagaa* fish drying and packaging; 4) fish processing and storage facility; 5) ice-block production; 6) cold room facilities; 7) water supply for human consumption; 8) poultry farming; 9) animal feed production; 10) brick production and building material supply; 11) polytechnic college; 12) soap production; 13) ICT services and computer training.

[15] JUMEME is setting up a relationship between a pump investor and smallholders (Peterschmidt, 2016).

A carpenter operates a lathe on Ukara Island

Credit: Energy 4 Impact

7.3.2 Strengthening micro-enterprises through business planning and enabling access to finance

One aspect of the JUMEME model that differs from CEFA and ACRA is that from the early stages the partners contracted external actors with expertise in enterprise development and value chains to work on catalysing productive energy use. Both Energy 4 Impact and Excel Hort Consulting deployed staff to stay in the communities, which increases their understanding of the local context.

Energy 4 Impact has set a target of supporting 50 local enterprises in Ukara. Their advisers work with micro-enterprise owners to develop business plans for energy use, help them source appliances and train them in how to use equipment, safety issues and business management skills. Staff involved in the work observed that, while it is possible to meet the target, the small size of these enterprises means their demand for power is still quite low. For JUMEME's owners, as a private mini-grid company working with equity investments, they need a faster uptake of demand in order to be successful.

Energy 4 Impact and JUMEME have also designed a financing scheme to help local enterprises purchase energy-related equipment. Under this scheme, JUMEME pre-finances part of the costs of a machine, which is then paid off by customers in instalments over several months. Customers who fail to pay instalments cannot purchase additional electricity except by first negotiating repayments with JUMEME. JUMEME has also run some short-term promotions with local entrepreneurs to generate interest in the early stages. This included either some grant element or waiving the requirement for customers to put up collateral. As a private company, JUMEME does not consider the provision of grants a viable option in the long term, given the need to generate profits.

The financing scheme is changing in that local SACCOs will now get involved in providing equipment loans to customers. In this new approach, JUMEME and the partners will propose to the SACCO specific enterprises they have vetted and worked with on a business plan, and the SACCO conducts its own due diligence before awarding a loan. The appeal for JUMEME is that involving the SACCO will minimise the financial burden on the company, though the process itself may become more complicated as more partners come on board.

The decision to involve the SACCO indicates an overall approach of the project developer working with existing financing actors, rather than becoming a financing agency itself. JUMEME's project staff have also searched outside the locality to engage financing institutions with a mandate to lend to small and rural businesses. These include the government agency Small Industries Development Organisation (SIDO), and EFTA – a Tanzanian private financing company targeting small and medium-sized enterprises and farmers.[16] It offers small businesses hire-purchase schemes for equipment, providing loans of up to US$60,000 without collateral, except the equipment itself (The Economist, 2016). At the time of this research the partners were developing a pilot with SIDO to install fish drying racks on Ukara, but not pursuing the opportunity with EFTA because the size of their loans is too large for local rural enterprises. Project staff members have identified some of the potential strengths and weaknesses of these different finance providers, highlighted in Table 3.

[16] See www.efta.co.tz

Table 3. Potential for JUMEME in partnering with local finance providers

	ADVANTAGE	DISADVANTAGE
Savings and credit co-operative organisation (SACCO)	• SACCOs can lend varying amounts up to a maximum of TZS20 million / US$10,000 • SACCO's due diligence processes are more streamlined than rural banks	• SACCOs cannot reach all of JUMEME's customers – only those who are members of the savings groups • Local entrepreneurs may still find it a challenge to raise the 50 per cent collateral required in SACCO schemes
Small Industries Development Organisation (SIDO)	• SIDO has a mandate to lend to small businesses	• SIDO staff lack budget to cover travel costs to more remote areas such as Ukara
EFTA	• Not reported	• Minimum loan of US$10,000 is too large for Ukara's micro-enterprises

7.3.3 Attracting inward investment through marketing and linking investor forums

JUMEME has plans for quite rapid expansion of the system. This creates pressure to build demand quickly; and supporting local micro-enterprises, which are quite low power users and take time to grow, is not creating sufficient demand. One particularly innovative strategy which JUMEME has therefore adopted is to attract larger inward investments by preparing an investment prospectus and engaging with business platforms, such as the Tanzania Chamber of Commerce, to spread the word to investors in Mwanza and elsewhere. Energy 4 Impact has been closely involved in developing the prospectus. It is too early to judge the success of this approach. At the time of the visit, Energy 4 Impact staff had identified potential interest from a social enterprise in a water supply public-private partnership, and from a private sector investor in a poultry farm.

7.3.4 Supporting activities in primary production and among women's groups

Another tactic Energy 4 Impact and Excel Hort are exploring is to support primary production activities which do not necessarily use electricity, but which could raise incomes locally; thus increasing the ability of residents to pay for household power. At the time of the research, JUMEME's partners were developing a pilot with SIDO to install fish drying racks, with the aim of producing more hygienically dried *dagaa* and securing a better price from buyers (Contejean and Verin, in press).

The advantage of supporting primary production activities, according to one interviewee, is that it builds on local people's existing activities and does not require them to develop extensive technical skills. JUMEME managers are more sceptical about the likely impact of these activities on the company's financial performance and have expressed a preference for support work to go directly into activities that use their electricity service.

A final area of support is for women's entrepreneurship, where JUMEME partners are again intervening at the point before an enterprise is using modern energy. The challenge is there are relatively few female business owners in Ukara, apart from hairdressing, restaurants and juice-making and agricultural activities, such as growing vegetables and drying fish.

Energy 4 Impact sees the main PUE barriers for women in their skill sets and access to finance. Rather than initiating a new women-led enterprise themselves, Energy 4 Impact staff have started off by encouraging women to form their own groups and start mobilising funds through their own savings and external sources. They have provided one group with a small office space for meetings and training, with the hope this could lead to new business ideas in the future. In the same building, the project has created space for an internet café with two computers, which could be run by a local person and used for ICT training.

7.4 Concluding remarks

Business customers in Ukara are just starting to use electric power and some of those we met felt that local life could improve as a result. For example, the carpenter had increased his production after he switched from doing all the labour manually to using electric machinery. However, it is premature to draw any conclusions on impacts, as the power had only just arrived at the time of the research.

JUMEME is testing some interesting interventions, from involving value chain and enterprise development experts at the outset, to developing an investment prospectus and exploring end-user financing options. Like CEFA and ACRA, JUMEME is also getting involved in supporting primary production activities that do not directly use power. For CEFA and ACRA these were driven by their broad poverty agenda as NGOs and by the need to get community approval for the project (since villagers' activities were disrupted by restrictions over local water resources used for the hydroelectric power). For JUMEME's partners, the aspiration is that supporting primary production could indirectly boost local demand for power through increases in households' income – though the firm's owners remain cautious.

Many of the challenges faced by JUMEME are similar to those experienced by CEFA and ACRA, but some additional lessons have emerged:

- Setting targets to supporting local micro-enterprises to build demand for power is important for local development, but insufficient on its own for achieving an economically viable service, given the timeframe, system expansion plans and the existing state of local enterprise. A private mini-grid company working with equity investments needs faster uptake of demand to be successful.
- The partners have had to be flexible in how they deploy PUE support budgets, adapting their plans as they build their understanding of the local context.
- It takes time to do PUE assessments, linked to the challenge in gathering robust data.
- There are potential opportunities to draw in investment and consumer financing partners from outside the locality, but there are still big hurdles – for instance in finding local partners with the appropriate lending model or even a staff travel budget to serve a remote community like Ukara.

The final section draws together all the learning and makes suggestions on 'Where next?' for project developers in Tanzania, the local organisations they partner with, government agencies and funders.

8

What are the key lessons and recommendations?

The three Tanzanian mini-grid projects studied are interesting, innovative and have had demonstrable impacts on local livelihoods, or – in the case of the new operator, JUMEME – have the potential for such impacts.

A common theme across CEFA, ACRA, JUMEME and their partners is the staff members' active efforts to stimulate productive energy use and demonstrate to local people what is possible with the arrival of electricity. All three take a holistic approach in the sense of going beyond the energy sector's traditional mandate of simply supplying kilowatts, to get involved in awareness-raising, skills training and facilitating end-user financing. Each of the case studies provide examples of innovation which are not typically on the PUE good practice checklist. These include, for example:

- Establishing agricultural enterprises which are integrated with the energy utility, providing an anchor client and driving economic development in the area (MVC/CEFA)
- Allocating permissions to local millers to purchase electricity in exchange for millers committing to charge lower prices than diesel competitors. The aim is to address local poverty and food security concerns, and manage demand on the system (LUMAMA/ACRA).
- Identifying larger-scale investment opportunities which require higher levels of energy demand than local micro-enterprises, and marketing these to actors outside the locality (JUMEME)
- Supporting livelihood activities that do not use electricity, as a way to either compensate for some of the negative impacts of new energy infrastructure on local people (CEFA/ACRA) or to indirectly build household demand (JUMEME).

The cases studied have different delivery models. The ACRA and CEFA-initiated projects are community-owned utilities, heavily grant-funded and essentially not-for-profit, with the dividends re-invested in community projects. JUMEME on the other hand is a private joint venture, which has raised significant grant financing but also debt and equity, and says it aims to become a profitable company.

We cannot say at this stage if one model or another is better in terms of stimulating local economic development in very poor and remote areas. As a private company working with equity as well as grants, JUMEME does have a stronger focus on cost-recovery and is under greater pressure to stimulate PUE demand quickly. However, it is striking that through its partnership with Energy 4 Impact and Excel Hort, JUMEME is enabling many recognisably NGO-type

activities. The support for primary production and encouraging women to engage in economic activities are two examples of this. The cross-fertilisation between the for-profit and not-for-profit sector goes the other way too: for future projects, CEFA and ACRA are developing a more commercially sustainable approach, raising tariffs in existing facilities and finding ways to partner with the private sector.

The cases studied reinforce what is already known about the barriers facing developers and local people in terms of achieving an economically sustainable energy service; while overcoming the pervasive problems of poor market access, lack of affordable finance and social inequality that stop people in rural areas using power productively.

To this we want to add some specific challenges our three developers have faced in actually carrying out PUE support measures, and make suggestions of what various stakeholders in Tanzania could do to address these.

CHALLENGE: Building demand by combining energy with an integrated rural livelihoods approach can increase local impacts, but this wider mandate involves time, expertise and costs.

The holistic approach that combines energy supply with wider rural development and community involvement interventions appears key to some of the positive impacts that CEFA and ACRA have had. At the same time, managers at LUMAMA and MVC suggested that there are some challenges to a holistic and bottom-up approach. For instance, establishing an integrated energy and agriculture business from scratch, or involving users in management decisions, are a significant undertaking and – while these may increase PUE impacts or local buy-in – they may also divert management time away from delivering an efficient, reliable energy service.

JUMEME has also taken a fairly integrated approach, and partnered with Energy 4 Impact and Excel Hort to access the expertise they lack themselves. In theory this allows the energy company to focus on service delivery, though in practice boundaries are blurred as the company also needs to build local relationships and be accountable to grant funders, like the EU, for the productive use impacts.

One emerging view across all the organisations is that it may not be private developers' role to become a permanent agency for enterprise development, by directly investing in, setting up or lending to individual micro-enterprises. Rather they see a case for themselves, and their partners, to support or facilitate demonstration projects to show what is possible and to inspire replication.

Recommendation 1

Developers need to invest in local awareness-raising and capacity-building – carried out by the right organisation

The experiences support good practice advice that in poor, remote communities which are getting electricity for the first time, investing in awareness-raising and capacity support may help speed up the usually slow process of PUE take-up. The fact that CEFA and ACRA have an established presence and relationships in the local area – rather than providing 'fly in, fly out' consultancy advice – is likely to be an important ingredient for success. JUMEME has a locally respected university as a shareholder, which the company finds is important for opening doors and building buy-in. Its contracted advisers have also arranged for staff to live locally during the pilot period.

Recommendation 2

Energy access funders and knowledge platforms should support collaboration between developers and rural enterprise advisory services

Bringing in external expertise makes sense in theory, but a practical challenge mentioned by interviewees is a dearth of strong, locally based organisations to support enterprise development – for instance advising on business plans, financial management, regulatory standards and marketing plans. In Tanzania, the Small Industries Development Organisation is a potential partner for developers, but there appear to be budgetary and physical constraints which means they do not have sufficient reach to many rural areas. This could be addressed by getting senior level buy-in at SIDO to support the Rural Energy Agency (REA) in delivery on rural electrification goals.

Because of the centrality of agriculture to development, the authors believe there should be a good base in Tanzania of agencies and farming associations with expertise in rural livelihoods and value chain analysis. But energy developers may need support in funding and finding these organisations – for instance through networking and 'matchmaking' services at conferences, knowledge platforms (Tanzania's mini-grids information hub) and industry associations (such as the Tanzania Renewable Energy Association (TAREA), the Alliance for Rural Electrification, the Africa Renewable Energy Association and the Global Off-Grid Lighting Association.

Recommendation 3

Support for local enterprises needs to be targeted and informed by a robust PUE assessment, and new good practice guidance tailored to local contexts.

Some interviewees from our case studies felt they had spread themselves too thinly in trying to support many different types of enterprise, and that the kind of showcasing effect could be better achieved by supporting a smaller number of initiatives. In our view, this reinforced the need for project developers and their partners to conduct a more in-depth PUE assessment in the design phase to help pinpoint the best opportunities. This would need to include a good gender analysis.

There are tools and approaches that can support identifying, prioritising, and analysing viability of particular local PUE business ideas. However, from our interviewees we identified a need to develop new guidance which is more specific to Tanzania, to particular types of energy service (mini-grids, off-grid), to particular geographic zones or particular sub-sectors. For instance, CEFA interviewees commented that they had done enterprise support in a fairly organic way and they are now interested to develop a toolkit on PUE. This would guide a mini-grid project on, say, 10 to 15 types of productive uses of electricity to improve the economic and financial sustainability of the project (Pendezza, 2015).

We tested this idea of developing more detailed guidance at the May 2016 workshop, and there was a significant positive response from stakeholders. People at the workshop also saw a need to share lessons among developers and stakeholders on their experience of putting such guidance into practice as a way to build knowledge and performance across the whole sector.

CHALLENGE: It takes time and money to promote PUE to low-income and marginalised groups, beyond the timeframes or risk profiles of many projects, lenders and investors.

The town of Matembwe has been transformed economically from an isolated and poor rural community to a thriving local economic hub, and our interviewees saw the access to power and related investments as a critical driver of that process. However, the process has taken three decades and the benefits are highly localised; un-electrified villages in the surrounding area remain quite poor and marginalised. This timeframe is beyond many project and investor lifecycles, which are usually around 4-5 years; they want to see quicker returns and larger-scale impacts. For instance, JUMEME's grant from the EU has a target to support 500 enterprises between the project's start in 2014 and 2018, which is ambitious given the starting point.

Designing and implementing effective PUE interventions takes time and costs money, yet – at a global level and in Tanzania – many stakeholders (project developers, government, development partners, social impact investors, NGOs) lack a clear idea of the costs involved and do not allocate sufficient budget for this. We can speculate that some project developers with limited local knowledge will underestimate the time and costs, or even expect local not-for-profit organisations do the demand-building side 'on the cheap'. Such an approach seems unlikely to deliver the hoped-for results or be a fair partnership.

JUMEME staff made a rough estimate that it takes them three to five days to do a PUE analysis for a micro-enterprise and several weeks for a full analysis of a sub-sector, like fish chilling or drying. The lack of good data is part of the time challenge, and it is only through piloting that JUMEME will get a better sense of the business and productivity possibilities of new, energy-enabled economic activities. With experience, good guidance and public sharing of data across the sector (for instance on rural energy consumption, or fishing incomes), this assessment phase could be sped up.

The projects have been heavily reliant on grant-based funding to support enterprise development and make power affordable. The Rural Energy Agency does have grant-based instruments, including matching grants (for feasibility studies, impact assessments and business plan development) and performance grants (to bring down capital investment costs). At the same time, many energy access funders are interested in loans and equity instruments in order to attract private sector investment, encourage economically viable projects and assure a return. Credit and equity may be appropriate for some energy access markets where technology costs have fallen and the business models are maturing (eg solar lighting products for peri-urban or 'middle' poor using pay-as-you-go), but many technologies serving poor people's productive energy needs, like mini-grids, are still at an earlier stage in terms of working out effective delivery models – so grant funding still plays a vital role.

All three cases studied are exploring different ways to overcome the huge end-user financing gaps. The common starting point is establishing short-term grant funds managed by the energy provider, or linking with local savings groups who provide loans (SACCOs), and JUMEME has explored other options such as working with SIDO. However, none of projects studied have worked out how to crack this conundrum yet.

Comparisons are sometimes made with the progress by solar home system providers in East Africa, who have combined mobile payments and remote data collection to increase efficiencies, reduce costs and allow small

incremental payments. These technologies can be used in PUE applications, but they may not solve the whole problem – since PUE equipment and the cost of using extra power is much more expensive than solar lighting products. It also depends on how much additional income the customer is able to generate to pay back the cost of buying new machines.

Recommendation 4

Proper budgeting and increased grant funding and patient capital is needed to incentivise PUE

Our case studies identified several financing needs on the developer and user side. These include:

- Funding to **conduct a thorough PUE assessment** as part of the project design (which goes beyond feasibility studies to look at outcomes for users)
- Funding for targeted **promotional activities** (training, enterprise support) or to innovate the energy service design in a way that helps stimulate local jobs and livelihoods
- Funding and energy model design innovations to make the purchase of energy and related electrical equipment **affordable for low-income customers** who want to develop their productive activities (cross-subsidies, pay-as-you-go technology, credit facilities)
- Funding **to measure PUE outcomes** in a reasonable time frame (eg 5-10 years after electrification), in order to evaluate success and share learning on what works and what does not.

At the early stage of innovation, our view is that some grant funding is still needed to help developers and their partners test different models for PUE stimulation. Contejean and Verin (in press) see a forthcoming reform of the World Bank's Tanzania Energy Development and Access Project (TEDAP) funding mechanisms as an opportunity to adjust the grant regime to incentivise productive energy use. The TEDAP currently provides grants based on the number of households connected and for pre-feasibility studies. Such funding lines could instead support in-depth PUE assessments and services targeted PUE in economically deprived areas.

There's a particular need for grant funding for delivery model innovation designed to tackle affordability gaps. For instance, LUMAMA have considered providing credit to consumers and retail businesses for starting up productive activities that make use of energy, linking it to their pre-paid customer payment system. Social impact investors with longer time horizons ('patient capital') and some grant mechanisms could also play a role in targeting riskier projects.

Our research did not identify what overall resources it takes CEFA, ACRA and JUMEME to carry out all the support and engagement activities, but these are likely to be significant given the size of the grants received. As developers prepare budgets for the new projects, there is an opportunity to share learning on the types and scale of project costs so that government agencies and funders get a better handle on the commitments involved.

Recommendation 5

Innovators in MSME and smallholder finance should share expertise and experience with the energy access sector

Many development organisations have been experimenting with ways to tackle the 'missing middle' in agricultural and smallholder finance, which refers to the reluctance or inability of commercial banks or microfinance to meet the financial needs along agricultural value chains, leaving primary producers and rural SMEs unserved (Doran *et al.*, 2009). The energy access sector would benefit from being linked with these organisations to understand the issues, what works and what does not, and collaborate on pilots together.

Recommendation 6

Policymakers, funders and developers should support partnerships and collaborations to help scale up impacts

CEFA and ACRA want to build on their current experience to form energy partnerships with the private sector as a way to achieve bigger scale impacts and combine the perceived strengths of both sets of parties. Those strengths are broadly understood as private sector's sound commercial management and investment-raising capacity on one hand, with NGOs' expertise on rural development and local relationships on the other. JUMEME, which is a private company, is testing this type of collaboration in its contracting with Energy 4 Impact and Excel Hort. Rift Valley Energy Ltd is a much larger commercial organisation running a mini-hydro facility in Tanzania, and also has experience of commissioning outside advice for PUE activities.

Diverse collaborations are common in the energy access field given the barriers to market-based solutions in reaching the poorest customers, and are recommended for stimulating PUE because energy providers cannot be expected to drive local economic development processes on their own.

These collaborations need to be encouraged, supported and learnt from. For instance, donor and government funders could convene multi-stakeholder partnerships, where energy providers team up with 'non-usual' suspects. Government also has a role to play in facilitating co-ordination between ministries and agencies from different sectors (see the next section). We should expect and encourage experimentation

and diversity in terms of the types of partnerships that support PUE stimulation. For instance, collaborations could be:

- **Project-based or sector-wide**. A project-based collaboration (like the ones in our case study) focus on a particular energy investment and local areas, while a sector-wide one might involve multiple stakeholders to problem-solve how to address particular PUE needs in a whole region or sub-sector (such as small-scale fishing, agriculture, forestry, agro-processing).
- **Holistic or narrow.** The CEFA-proposed model is quite holistic, involving close partnerships with different actors who would jointly design and deliver a particular energy service. The JUMEME approach appears more narrowly based, involving shorter-term collaborations around a specific activity, such as commissioning an enterprise support organisation to provide training to customers.

Partnerships can also be fraught with challenges as organisations bring different values, ways of working, commercial imperatives and resources. Often it takes several years to build an effective relationship. As this experimentation takes place, there is a key role for research in mapping the different models, understanding the incentives and barriers for different parties to work together, and sharing learning on what works in different contexts.

CHALLENGE: Tanzania has an enabling environment for energy access, but specific policy measures may be needed to accelerate productive energy use.

The case studies have focused on activities inside the energy delivery model, ie how can project developers and their partners catalyse jobs and livelihoods? Yet the good practice guidance also highlights the importance of external factors and whether an enabling environment exists. The 'enabling environment' can be extremely widely construed to include all the policy, regulatory and financial levers that could make a mini-grid investment or other type of energy access projects attractive to a developer – such as feed-in-tariffs, permitting rules, risk guarantee mechanisms and subsidies.

Tanzania is considered to have a supportive regulatory environment for mini-grid and off-grid activities, though some barriers do remain, for instance where developers are unaware of grid expansion plans (Tenenbaum *et al.*, 2014, AfDB and CIF, 2015). This wider enabling environment is critical: unless investments are viable, no job creation can happen. However, the challenge is to identify whether there are additional, specific measures that could help energy providers and local stakeholders do more to stimulate productive energy use. This is not well covered in the existing literature, particularly for decentralised energy.

The Rural Energy Agency (REA), as the main government agency responsible for promoting rural electrification, has a goal to work with others to "promote and facilitate development of rural energy projects for productive use to stimulate social and economic development" (REA, 2015). Having this high-level mandate is important; though it is not clear what tools or supports REA has at its disposal to help achieve this. There are some entry points. For instance, Tanzania's National Electrification Program Prospectus uses the concept of 'development centres' to assess and prioritise settlements which have the infrastructure that would enable it to maximise the benefits of electrification, including for productive purposes (such as administrative infrastructure, business activities, good road access). This is mainly focused on grid extension and grid densification, though it does identify 19 development centres suitable for off-grid projects (small hydro plants) (IED, 2013). REA's matching grants and performance grants could also provide funding mechanisms which could be used to support PUE assessments and design measures, and address affordability challenges by contributing to capital investment costs.

Cross-sector co-ordination is another key challenge. Stimulating productive energy use is a classic cross-sector issue. Several participants in our research noted that, except for specific permitting or regulatory roles (eg the Ministry of Water issuing hydro permits), there is a gap at the moment whereby Tanzania's energy sector remains largely focused on expanding supply, while non-energy sectors which have crucial expertise – for instance around agricultural development or women's entrepreneurship – are not much involved in energy access investments, planning and delivery. Relevant non-energy sectors could include ministries of agriculture, livestock and fisheries; water and irrigation; health, community development, gender, seniors and children, as well as local government. A report by the Tanzanian research organisation REPOA on job creation and electrification in Tanzania identified the need for information-sharing across ministries and other stakeholders, as well as a co-ordinated strategy around skills development, particularly in the electrical trades (Mwakapugi *et al.*, 2010).

This whole area requires further research; however, some initial starting points for discussion and consultation are offered below.

Recommendation 7

Increasing cross-sector co-ordination, policy signals and financial incentives could promote more integrated approaches to energy access and rural development.

Stakeholders attending our May 2016 workshop wanted to see much better collaboration between ministries and with the REA, and fewer transaction costs for developers in having to engage with lots of different agencies. Some of the possible mechanisms suggested include:

- **Establishing shared performance indicators** across ministries relevant to PUE, starting with a consultation with the Planning Commission to establish what already exists and where the gaps are
- **Public sharing of sectors' key investment plans and data sets** to help developers identify opportunities for energy as a complementary investment (eg water supply, agricultural corridors, grid extension plans, renewable energy resource maps)
- **Using REA grants to fund PUE assessments and incentivise PUE services** and connections in harder-to-reach population groups and geographies (stated earlier)
- Creating policy interventions to promote the development and use of **energy-efficient appliances**
- Creating incentives for users and energy developers adopt or promote **PUE equipment**, eg through tax rebates.

Recommendation 8

Governments and funders can support innovation through facilitating access to advice, guidance and networking

A repeated call in this research is for more information, guidance, networking and sharing learning between innovators and local organisations that could support them. The Tanzanian government and development partners could support this. A particular priority is supporting the development of publicly available information on particular rural sub-sectors that productive energy investments could target – an example given here was generating information on incomes, value chains, markets and production values in fishing and horticulture. Funders gather this information from projects they fund and could help make it publicly available.

One promising vehicle for disseminating information is the mini-grids initiative funded by the Scaling-Up Renewable Energy Program (SREP). This will produce a series of business support tools and standards to help build the market infrastructure and enabling business environment. It will also provide developers with a specific advisory service to support transactions – for instance developing business models and plans, and doing feasibility studies. An online information portal has already been launched covering areas such as law, policy, tariff and grant application processes. A facility like SREP could consider expanding its role to provide targeted support around PUE assessments and design interventions, matchmaking developers with local organisations, and sharing PUE-related information on line.

Additional learning and networking spaces would still be needed for energy providers and stakeholders working on off-grid services, including for standalone equipment (eg irrigation pumps, multi-functional platforms, solar kiosks) and on grid extension. There are many other platforms and spaces that could assist, in Tanzania and beyond, from TAREA and the Energy Change Lab to the many energy access conferences held in the region.

About the Energy Change Lab

This research is an activity of the Energy Change lab (www.energychangelab.org), a multi-stakeholder initiative founded by Hivos and IIED. Energy and jobs is a priority theme identified in our consultation with stakeholders in Tanzania. We are building on this research to design a Productive Use of Energy action-learning programme in Tanzania. The programme (2017–2018) will support developers and non-energy stakeholders design and test PUE assessment and support measures, and share these learnings across the sector. We are interested to discuss with others how we might collaborate on finding practical solutions.

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Annex 1. Interviewees and workshop attendees

We conducted research interviews and scoping meetings for this project in Tanzania in June and October 2015 and May 2016. In addition, as part of our field research, we met with several small business owners and community members in Matembwe, Ikondo, Uheni (CEFA), Mawengi, Milo and Msanyo (ACRA) and Ukara (JUMEME). The following is a list of people and organisations who took part.

List of interviewees

ORGANISATION	NAME
Ardhi University	Professor Mgana
AECF	Aly Breedlove Damian Casmiri
ACRA	Davide Ceretti Marco Tancredi Mr Thomas
Aweta Energy	Robert Matiku
CEFA	Dario De Nicola Jacopo Pendezzo Francesca Baravelli Evanton Willilo Virgilio Kiwhele
EU Delegation to Tanzania and the East African Community	Mikael Melin
DfID – UK Department for International Development	Tim Bushell
Energy 4 Impact (formerly GVEP)	Adam Mbwambo Fredrick Mushi Emilian Msangi
Independent consultant	Steve Thorne
JUMEME Rural Power Supply Ltd	Giuseppe Buscaglia Mathias Athanas Egberth Bashweka
LUMAMA	Mr Eric (General Manager) Members of LUMAMA management team and Board
Ministry of Energy and Minerals	Edward Ishengoma

ORGANISATION	NAME
Matembwe Village Company	Johanes Kamonga Mr Ishmael Mr Christopher
Rural Energy Agency	Boniface Gissima Nyamo-Hanga Grace Mathew Vestina Rwelengera
Rift Valley Energy Ltd	Franz Kottulinsky
Norges Vel	Fredrick Tunutu
SNV	Martijn Veen
IFC-SREP	Andrew Mnzava
World Bank	Lara Born
Ukara Village Power Committee	Lazaro Kabunga

We also held a workshop in Dar Es Salaam in May 2016, attended by 40 stakeholders; these are listed below.

Attendees at the PUE workshop in Dar es Salaam, 20 May 2016

NAME	ORGANISATION
Sisty Basil	ECL co-ordinator
Sarah Best	IIED
Ben Garside	IIED
Felia Boewinckel	Hivos
Eco Matser	Hivos
Sandry Smithey	Charles Stewart Mott Foundation
Caroline Kariuki	ACRA Foundation
Jesca Samwel	TANESCO
John Raymond	TIRDO
Ansi G. Mmasi	Baraka Solar
Josh Sebastian	SNV
Emmanual Michael	UNIDO
Saad Latif	MOBISOL
Henry Massawe	TBS
Sr. Imakulata	Benedictine Sister of St Gertrud Imiliwahi
Dr. Gerd-Henning Vogel	GIZ
Anicet Vincent	NORPLAN (T) LTD
Hitoshi Suzuki	Embassy of Japan
Bahati Joram	Ministry of Water
Andrew Mnzara	IFC
Leanne Jones	DFID
Alicia Rutajumbukilwa	Ensol
Arthur Karomba	Energio Verda
Monica Blaalid	Norwegian Embassy

NAME	ORGANISATION
Tomo Sandeman	Energio Verda
Victor S. Labaa	EWURA
Florent Dhôte	Husk Power Systems
Steve Thorne	Energy Transformation
Justina Uisso	REA
Barnabas Lupande	REA
Fabio de Pascale	Devergy
Abel A. Kinyondo	REPOA
Gerald Kafuku	COSTECH
Adam Mbwambo	GVEP International
Diana Mbogo	independent
Representative	Ministry of Agriculture
Hellen Mutabahirwa	Ensol

Annex 2. Interview questions

Our interviews were conducted on a semi-structured basis. The following questions were used to guide our field research with CEFA, ACRA and JUMEME.

1. How did you analyse and decide which type of productive uses of energy the electricity service could support?
    a. What are the market opportunities for these activities?
    b. What types of problems and barriers do these enterprises or sub-sectors face?
    c. How did the seasonality affect issues like paying and the overall design of the energy service?
2. What type of support activities have you provided potential customers, such as business training, grants, support to milling services? What types of interventions worked, what didn't work and why?
3. Do you target women-specific enterprises? Do you take any special measures to address gender issues around productive uses?
4. Who do you need to work with and why? What is the interest of district and/or regional authorities?
5. What do customers need finance for in terms of building their businesses? Where do they get their financing from and how does microfinance help?
6. What role does the community-run utility play in supporting productive uses of energy? What additional things could the utility be doing? What might it stop doing?
7. What is the most significant change that has happened in the communities?
    a. Is the project measuring impacts?
    b. Have there been any negative impacts from electrification, for example reduced employment where people are replaced by machines?
8. With the new projects in the design phase, what is being done around PUE and how does it differ from early projects? Do you have information on the resources involved (staff, funding) to support PUE?

Annex 3. ACRA hydro projects – Mawengi and Lugarawa

NAME	MAWENGI	LUGARAWA
Developed by	ACRA, local government – Njombe Development Office, Catholic Church	ACRA, Njombe Development Office, Hospital of Lugarawa, Studio Frosio (engineering firm)
Location	Municipality of Mawengi Ludewa District Region of Njombe	Lugarawa, Ludewa District Region of Njombe
Year started	Construction started in 2006, operations in 2010	2014-18/19 (grant period)
Management and ownership	LUMAMA Electricity Association owns and manages the service. District government and church partner have positions on the board. Three levels of user involvement through membership on 26 transformer committees, 8 zonal committees and 1 general assembly.	Establishing new private utility with mixed ownership: 40% user groups; 55% Lugarawa hospital; 5% Njombe Professional College Three levels of user committees: transformer, zonal, board
Capacity	300kW run-of-the-river system	1.7MW hydroelectric plant – running river project plus water storage to manage peak demand
Finance	€7,748,265 Funders: Italian Ministry of Foreign Affairs, Intervita Onlus, EC, Region of Lombardy, Rural Energy Agency (Tanzania)	€7,568,677 Principally EC, with support from EEP, UNIDO and REA
Connections	Distribution to 9 villages (Madunda, Lupande, Kiwe, Mapogoro, Milo, Mavala, Mdete, Lufumbo, Mlangali) 1,400 connections at time of research – households, small businesses and public services (schools/health centres/ water supply system). 1,600 connections due 2016	Target to provide energy to 53,000 people in 20 rural villages 4,000 connections planned by end of 2018. Plans to connect 43 schools, 19 health clinics, 1 hospital, 232 shops and workshops and 118 mills Will also connect to national network with a standard power purchase agreement with TANESCO

NAME	MAWENGI	LUGARAWA
Connection costs and tariffs	Typical connection cost is TZS180,000 and a credit scheme (revolving fund) provided for customers in first phase so customers only pay 20% up front Customers pay (through pre-paid meter) a monthly service fee plus their own electricity consumption with rates varying according to customer For a household the average payment is TZS8,000 per month; for small industry TZS200,000 per month	To be proposed to and approved by EWURA

Sources: ACRA, undated; EC and ACRA-CCS, 2014; authors' interviews.
Notes: EEP: Energy and Environment Partnership; UNIDO: United Nations Industrial Development Organization.

Annex 4. CEFA hydro projects – Matembwe and Ikondo

NAME	MATEMBWE	IKONDO
Developed by	CEFA, Catholic Church – Njombe diocese	CEFA
Location	Serves villages of Matembwe and Image, Njombe District	Village of Ikondo, District of Njombe
Year started	1981	2004
Management and ownership	Management by Matembwe Village Company (MVC Ltd), established 1999. 4 shareholders: Catholic Diocese, District of Njombe, Village of Matembwe. CEFA ended its 25% share in 2014 and MVC established as employee co-operative. 5% of profits distributed among shareholders and 25% kept by the company to use for social interventions, eg rehabilitating schools	Currently owned by CEFA but being handed over to MVC Ltd
Capacity	120kW reservoir micro-hydro plant	80kW run-of-the-river plant. Currently being scaled up to 430kW under Ikondo II project (which will reach 4 new villages and connect to Matembwe grid)
Finance	Grant financing from: Italian Ministry of Foreign Affairs, Belgium Ministry of Foreign Affairs, EC	Grant funding from Italian Ministry of Foreign Affairs, EC, CEFA
Connections	556 households, 64 public institutions and economic activities, 4 aqueducts* Also connects to TANESCO grid	Currently serves around 130 households, 46 public institutions and economic activities, 1 aqueduct* Ikondo II will add 280 households and 75 public institutions/economic activities Also intends to connect to TANESCO grid to sell excess production
Costs and tariffs	Graduated tariff rates according to use: households TZS140/kWh; businesses TZS200/kWh; public institutions TZS70/kWh. Tariffs being increased to reach parity with TANESCO (TZS250/kWH for households and TZS350/kWH for businesses)	Establishing a €10,000 fund entrusted to the local SACCO to help with connection costs

*These are taken from Pendezza (2014)

Sources: CEFA (2014); Pendezza (2014), Pendezza (2015).

Annex 4. JUMEME Rural Power Supply Ltd

Name	JUMEME Rural Power Supply Ltd
Developed by	Joint venture by INENSUS, St. Augustine University of Tanzania, Terraproject and RP Global
Location	16 rural towns and villages, lake zone, northern Tanzania
Year started	2014
Management and ownership	Private-sector owned and managed. Aims to become sustainable and profitable company. Village power committee established to engage with company, eg information sharing, dealing with safety issues and complaints
Capacity	Solar diesel mini-grids Phase I of the pilot project on Ukara Island consists of the installation of a mini-grid of 7-kilometre 230/400 volt low-voltage lines, a 60kWp solar PV system, a 240kWh battery bank, 54kW bidirectional battery inverters and a 33kVA diesel generator
Finance	Project costs of €16 million, including €7.4 million EU grant plus equity and debt. Funds for technical assistance and impact assessments are also provided by Energy and Environment Partnership (Southern and East Africa), the Sustainable Energy Fund for Africa (managed by African Development Bank), the Overseas Private Investment Corporation and the Global Climate Partnership Fund
Connections	Goals include reaching: 81,000 people, 11,000 households, 2,600 businesses, 42 public offices, 32 schools, 12 health centres, 77 religious buildings, and creating 500 businesses
Connection costs and tariffs	No connection charges or fixed charges to customers, apart from 50% of the indoor installation costs (varies by size of installation). These costs of connection and installation are therefore integrated into the tariffs Variable monthly rates depending on household, commercial (small shops) or industrial customer, ranging from TZS1,000 / week to TZS2,000 / week for household or commercial users, to TZS10,000 / week for industrial customers 'Pay as you go' tariff (TZS40 per hour of 3W lighting) offered to customers with low usage and irregular income streams – this comes with a basic household installation in a 'starter package' For high industrial users (eg mills), JUMEME offers a Productive Use Dual Tariff, which offers low-cost electricity during the daytime. There is also a solar excess tariff for irrigation pumps, which is available when the batteries of the hybrid system are fully charged and which provides electricity at near the TANESCO tariff level Mobile money payment platforms are being introduced

Sources: Peterschmidt, undated; JUMEME and EU, 2015.

Abbreviations

CEFA	European Committee for Training and Agriculture
EEP	Energy and Environment Partnership
EU	European Union
GIZ	German Society for International Co-operation
kVA	kilovolt amp
kWh	kilowatt hour
kWp	kilowatt peak
MVC	Matembwe Village Company
MSMEs	micro, small and medium-sized enterprises
NGO	non-governmental organisation
PRODUSE	Productive Use of Energy
PUE	productive uses of energy
REA	Rural Energy Agency
REF	Rural Energy Fund
SACCO	Savings and Credit Co-operative Organisation
SIDO	Small Industries Development Organisation
SREP	Scaling-Up Renewable Energy Programing Low Income Countries
TANESCO	Tanzania Energy Supply Company Limited
TAREA	Tanzania Renewable Energy Association
TZS	Tanzanian shillings
UNIDO	United Nations Industrial Development Organization
VICOBA	Village Community Banks

While rural energy access investments – like mini-grids – can be expected to transform local economies, this doesn't happen automatically. Catalysing local enterprises and raising incomes through productive uses of energy often requires extra measures, to overcome barriers such as gaps in local people's skills or financial resources. In Tanzania there are huge opportunities for ambitious energy access investments to increase rural productivity, including milling, irrigation and small and micro-enterprises. This paper examines the experiences of two mini-hydro projects in Njombe region run by NGOs, and a solar-diesel mini-grid project in Tanzania's lake zone run by a joint venture company. All three are exploring ways to combine energy with wider rural development processes. The paper investigates what interventions work, and offers recommendations for new entrants, policymakers and funders.

IIED is a policy and action research organisation. We promote sustainable development to improve livelihoods and the environments on which these livelihoods are built. We specialise in linking local priorities to global challenges. IIED is based in London and works in Africa, Asia, Latin America, the Middle East and the Pacific, with some of the world's most vulnerable people. We work with them to strengthen their voice in decision-making arenas that affect them – from village councils to international conventions.

Hivos is an international organisation that seeks new solutions to persistent global issues. With smart projects in the right places, Hivos opposes discrimination, inequality, abuse of power and the unsustainable use of our planet's resources. Counterbalance alone, however, is not enough. Hivos's primary focus is achieving structural change. This is why Hivos cooperates with innovative businesses, citizens and their organisations – sharing a dream with those organisations of sustainable economies and inclusive societies.

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This research was funded by DGIS and UK aid from the UK Government, however the views expressed do not necessarily reflect the views of the Dutch Government or of the UK Government.