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A Potential Role for AMCs in Promoting Green Mini-Grids in Tanzania

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Executive Summary

This annex considers how Advance Market Commitments (AMCs) might be used to promote the development of green mini-grids in Tanzania. It is one of two case studies Vivid Economics has undertaken to complement its report on the economics of AMCs. The second case study concerns the development of micro- Concentrated Solar Power (CSP) in India. The two cases are intended to illustrate the AMC concept. They are not project proposals and have not been subjected to the level of scrutiny an actual proposal would be.

There is an urgent need to improve electrification rates in rural Tanzania. In many parts of rural Tanzania, less than 2% of the population has access to electricity. In line with a wide variety of studies, evidence from Tanzania shows a strong positive correlation between electrification rates and higher levels of economic activity and quality of life.

Green mini-grids represent an attractive source of electricity in many parts of rural Tanzania. Many parts of Tanzania are a long way from the main electricity grid and have little realistic prospect of becoming connected in the near future. Solar home systems are a viable option for lighting, but typically do not provide enough power to run machinery and hence do not allow many types of business to flourish. Compared to mini-grids powered by diesel generators, green mini-grids offer the prospect of more reliable and cheaper electricity, as well as greenhouse gas emission reductions.

Policies that resemble AMCs have recently been introduced to realise the benefits of green mini-grids in Tanzania. Standardised Power Purchase Agreements (SPPAs) and associated Standardised Power Purchase Tariffs (SPPTs) offer more lucrative and more certain revenues for producers of renewable electricity wishing to sell power to mini-grids (currently all owned by the national state utility, TANESCO) than were available previously. Likewise, the World Bank's Tanzania Electricity Development and Access Project (TEDAP) offers a performance grant of $500 for each additional connection made to a mini-grid. This can be thought of as an AMC: making revenues to be obtained from connections higher and more certain than previously.

This suggests that any further AMCs will be consonant with the existing policy direction, but also that care needs to be taken not to duplicate the existing policy framework.

Two sets of AMC interventions are presented. These interventions differ depending on whether the power generator is distinct from the company responsible for the distribution and supply of electricity ('unbundled' model) or whether all activities are undertaken by an integrated company ('bundled' model). The former case is more likely to be relevant in trying to encourage the switch from diesel generation to renewable generation at the existing (TANESCO owned) mini-grids. The latter case is likely to be more relevant in encouraging the development of new mini-grids. In both cases, the potential interventions are intended to complement and support the existing regulatory and policy arrangements.

First, the sale of power by renewable power generators to mini-grid operators, as governed through the standardised power purchase agreement and tariffs, could be made more certain and/or more lucrative in a number of ways.

— In terms of greater certainty, investors have expressed concern that TANESCO may not always provide timely payment of the standardised tariff. There is also a broader policy concern that the regulatory framework may be redesigned. Such doubts about policy credibility are often expressed by investors contemplating low-carbon investments in the developing world. The risk is real, but some form of policy risk insurance or partial payment guarantee could help address this barrier.

— A number of AMC interventions are possible to make renewable energy more lucrative. International donor money could be used to 'top-up' the purchase price paid by the local community to provide a more accurate reflection of the costs avoided by not using diesel generators to power the mini-grid. It could also involve intervening in the event that diesel prices, which determine the tariff for renewable power, become 'too low'.

Second, AMCs could be used to promote the development of new mini-grids. Such new mini-grids are likely to be integrated across power generation and distribution

and supply. Currently they are supported by capital grants from the Rural Energy Agency. There are a number of problems with exclusive reliance on this approach including the possibility that capacity may be built but power not delivered to the local community. An alternative approach would be to use international donor funds to top up the electricity price received by mini-grid operators. This would allow capital cost recovery while ensuring that the power remained affordable to the local community. An attractive feature of this proposal is that this augmented price could be calibrated to the price available to those selling renewably generated power to TANESCO under the SPPTs.

This proposal would look very similar to the pneumococcal AMC. A key challenge for this intervention would be to provide sufficient credibility that the higher prices would persist enough to provide for capital cost recovery, essential if the projects are to be financed at reasonable cost. Lessons from the pneumococcal experience will be valuable, while there would also be advantages for donors who were providing the AMC support to also provide (concessional) finance.

AMCs on their own are insufficient: supply-side support measures for the development of green mini-grids in rural Tanzania are essential. Feedback from investors and stakeholders suggests that the most important support measures would be to increase the level of grant support for feasibility studies and capacity building to assist project developers in developing 'investment ready' business plans. Access to credit also represents a key barrier. In both cases the World Bank has recently introduced initiatives to address these barriers although it is, as yet, unclear how successful they will be.

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1 Introduction

This annex presents a case study exploring how AMCs can be applied in practice to scale up rural electrification in Tanzania by promoting investment in green mini-grids. It is one of two case studies that have been developed to complement our report on the economics of AMCs. The purpose of the case studies is to illustrate the AMC concept in a practical context. However, they have not been developed to the level of detail that an actual project proposal would be.

There are good reasons for promoting rural electrification in Tanzania and green mini-grids may be an effective way of doing so. Section 2 makes the case for green mini-grids and explains why they are a potentially cost-effective means to scale up access to electricity in Tanzania.

Over the last years some AMC-like instruments have emerged in the regulatory framework in Tanzania. This suggests that any further AMC developments will be in line with the current policy in Tanzania, although it also suggests that care needs to be taken to avoid duplication. These developments are described in section 3.

Investment barriers remain that could be tackled through the use of AMCs. Section 4 of the case study elaborates on what role AMCs can play in overcoming them. AMCs may help to increase certainty and revenues for investors in the generation or distribution of rural electricity. To a significant extent these suggestions would involve scaling up or providing greater certainty around the existing regulatory and policy framework.

There are other investment barriers that would require non-AMC interventions. Section 5 describes complementary policies that need to be pursued in order to exploit the full potential of the existing and potential AMC policies. A 'supply push' will tackle the early stages of project development to the point when the 'demand pull' from the AMC could be successfully used to

drive the further development, led by private sector investments.

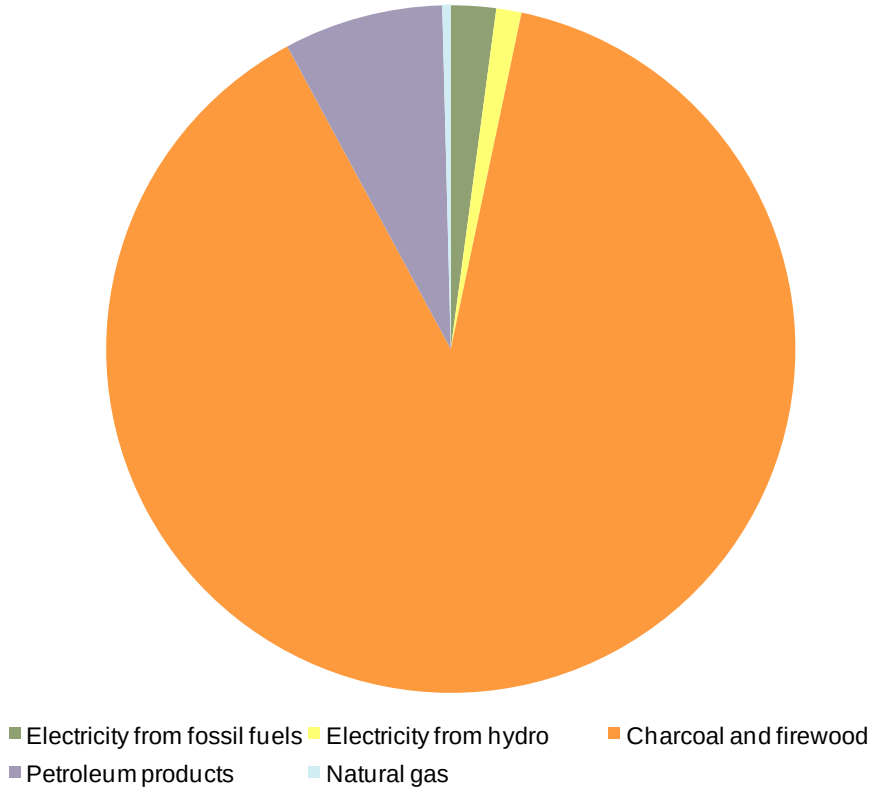
2 Why do green mini-grids have a role in providing power in Tanzania?

2.1 Why mini-grids?

There is an acute lack of access to electricity in Tanzania. Despite recent initiatives, domestic use of electricity is almost exclusively concentrated in urban areas and less than 10% of households in Tanzania have access to electricity. In rural areas, where 80% of the population live, access falls to below 2%.[1] Charcoal and firewood remain the dominant sources of firewood (Figure 1).

[1] Tanzanian National Bureau of Statistics: http://www.nbs.go.tz

Figure 1 In 2007, charcoal and firewood were the dominant source of energy in Tanzania



Source: IEA

There is a large suppressed demand for access to electricity. Demand for electricity services remains suppressed because access to the grid is often constrained due to a shortage of infrastructure or financial resources. To satisfy this suppressed demand, the installed capacity would need to be 50%, or 570 – 620 MW, higher. Moreover, suppressed demand is growing by around 8% per year.[2] Thus, installed generation capacity will have to increase threefold by

[2] Kabaka, K. and Gwang'ombe F. (2007), Challenges in Small Hydropower Development in Tanzania: Rural Electrification Perspective, International Conference on Small Hydropower, Sri Lanka, 22-24 October 2007.

2030.[3]

There are large differences in economic activity and standards of living between villages that have access to electricity and those that do not. Case studies in Tanzania show that the growth rate of micro-enterprises was noticeably higher in areas with electricity services than in areas without.[4] Furthermore, a survey by the Ministry of Energy and Minerals[5] found that for the vast majority of villages new manufacturing and commercial activities started after the electrification. This survey data also indicated higher monthly incomes in electrified areas compared to similar un-electrified areas.

The electricity grid is rundown and unable to cope with additional power supply, particularly from renewables. Ongoing financial difficulties at TANESCO (the state-owned utility) have resulted in very little investment in grid infrastructure and maintenance. The World Bank[6] assessed grid expansion as unfeasible until the network's technical capacity is upgraded and TANESCO's financial situation is improved. It concluded that additional 132kV transmission lines and substations are urgently needed in areas with high load. These investments will increase the feasibility of adding further renewably generated power to the main grid. However, the priority investments are all in urban areas and will not benefit the rural population directly.

Recent droughts have shown the weaknesses of the main grid and proved very costly. Severe droughts in 2005/2006 led to reduced water levels and

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[3] Economic and Social Research Foundation (2006), Mkukuta based MDGs costing for the energy sector, Dar es Salaam.

[4] Maleko, G. (2005), Impact of electricity services on microenterprise in rural areas in Tanzania, Master's thesis, University of Twente, Enschede.

[5] Ministry of Energy and Minerals (2005), Tanzania Rural Electrification Study, Master Plan and Programme Report (Phase 1), prepared by DECON, SWECO and Intern-Consult

[6] World Bank (2007), Project Appraisal Document for an Energy Development and Access Expansion Project, Energy Unit, Sustainable Development Department, Eastern Africa Country Cluster, Report No. 40771-TZ.

many hydro dams were unable to operate. The government started power rationing in February 2006 and commissioned emergency thermal power plants with operating costs of 30-50 US cents per kWh. Climate change could exacerbate the problems the main grid suffers due to the large share of hydro power in the main grid. Achieving greater rural electrification through alternatives to grid extension are likely to become more attractive in the future.

Solar Home Systems do not provide enough capacity for productive uses of energy. An alternative to rural electrification through mini-grids is to use Solar Home Systems (SHSs). The roll out of SHSs has been especially successful in the Mwanza region. However, most users buy systems in the range of 14-60W_p[7]. Larger systems for institutions and micro enterprises can be up to 400W_p. These can power a few fluorescent lamps and a fan, TV or radio but cannot be used to power machines. Businesses may also lack the considerable upfront costs involved in installing their own solar PV system.

2.2 Why green mini-grids?

Renewable energies can already be cost-competitive in many mini-grid situations. While fossil fuels remain the lowest cost option for feeding power into the grid, renewables are often cost-competitive in mini-grid situations. In 2005, the Tanzanian Ministry of Energy estimated diesel generation costs in rural areas to be 15-27 US cents per kWh.[8] Recent calculations by the regulator EWURA suggest a cost as high as 44 US cents per kWh.[9] These high costs are often caused by a lack of maintenance and availability of spare parts, as well as high fuel costs. By contrast, modelling of electricity generation costs by

[7] Parpia (2007), Providing affordable solar systems in Northern Tanzania, Technical Report, Zara Solar Ltd., The Ashden Awards for Sustainable Energy.

[8] Ministry of Energy and Minerals (2005), op cit.

[9] This is the cost of diesel generation embedded within the mini-grid standardised power purchase tariffs for 2009 converted to US cents using a February 2010 exchange rate. See EWURA (2009) 'Guidelines for developers of small power projects in Tanzania' July.

ESMAP[10] show comparable or lower global average costs for many renewable energy technologies. Micro-hydro is estimated at 8-12 US cents per kWh, biomass gasifiers around 10 US cents and wind energy at 15-25 US cents. Only solar PV remains very expensive at 40-70 US cents per kWh (Table 1). Comparisons with projects in other East African countries and feasibility studies for Tanzania suggest that these global estimates remain valid in a Tanzanian context, apart from solar PV, which costs up to 100% more than the global average. This is due to import duties and the comparatively small system sizes sold in Tanzania, which bring up costs per Watt.

There are abundant renewable energy resources that could be exploited. As Table 1 below shows, current levels of exploitation are well below the estimated potential. By contrast, most of the 12 existing isolated diesel power stations do not produce adequate power. In many regional trading centres, like Kigoma, electricity supply is rationed to a few hours a day and load shedding and power interruptions are frequent.

[10] ESMAP (2007), Technical and Economic Assessment of Off-grid, Mini-grid and Grid Electrification Technologies, Technical Paper 121/07, Energy Sector Management Assistance Program, World Bank.

Table 1 There is opportunity to exploit renewable power for mini-grids in Tanzania at a cost comparable to conventional diesel generation

	Generation costs for Tanzania (US$/kWh)	Estimated energy potential	Current level of exploitation
Diesel generators	0.15-0.45		~ 15 MW
Biomass	0.08-0.30	Depends on sustainability of supply but at least 30 MW.	3 MW from forest residues, 0.3MW from sisal waste.
Wind	0.15 - 0.20	not fully assessed	~ 60 operational wind mills for water pumping
Mini- and micro-hydro	0.05-0.40	~ 250 MW	4.2 MW
Solar	1.00-2.00	good radiation properties in much of the country	a few thousand Solar Home Systems, amounting to ~ 1.2MW.

Source: GVEP International, ESMAP (2007), ESRF (2006), EWURA (2009), Abaka and Gwang'ombe (2007) and World Bank (2007).

Local circumstances will dictate the precise cost comparison. While the table shows the best estimates of average costs for these various technologies in Tanzania, the precise figures will depend on local circumstances and technology.

Experience suggests that the generation costs of green mini-grids may be affordable for parts of the rural population. An independent village co-operative in Urambo supplies around 250 customers with electricity from a 100kW diesel generator for 47 US cents per kWh. Although the tariff is 15 times higher than in the nearest grid-connected town and registration and connection fees of US$ 12 apply, the number of customers is growing despite the lack of subsidies (Ilskog et al., 2005).[11] However, other project developers and investors, consulted as part of this project, have suggested that in other parts of

[11] Ilskog, E. Kjellström, B., Gullberg, M., Katyega, M., and Chambala, W., (2005), Electrification co-operatives bring new light to rural Tanzania, *Energy Policy* **33**, 1299–1307.

the country, willingness to pay is unlikely to exceed 10 US cents per kWh which is below the costs of production outlined above. In these cases, some form of subsidisation will be required for electrification.

There is some evidence of local capacity to operate and manage independent power production. A recent study found at least 10 companies in the country with potential capacity, although operational skills and investment capital are weak.[12] Also the rural electricity cooperatives in Urambo and Mbinga provide indications that with appropriate incentives, access to finance and the right capacity building, local private investors can be capable and willing to invest in rural electrification.[13] Although this local capacity exists, as discussed further in section five, further interventions are likely to be required in order for it to be fully realised.

2.3 Possible locations

Opportunities for green mini-grids exist in many parts of the country. There are clear opportunities where regional trading or administrative centres remain un-electrified. The Ministry of Energy[14] in its Rural Electrification Study identified 23 regional clusters based on population density, socio-economic development potential and electricity demand. Table 2 below shows 5 areas that appear promising in terms of the economic conditions for development, excluding a further 2 for which grid connection was assessed to be more economical.

[12] Marandu, E. (2002), The prospects for local private investment in Tanzania's rural electrification, *Energy Policy*, **30**, 977-985, 2002

[13] Ilskog et al (2002) op. Cit.

[14] Ministry of Energy and Minerals (2005), op cit.

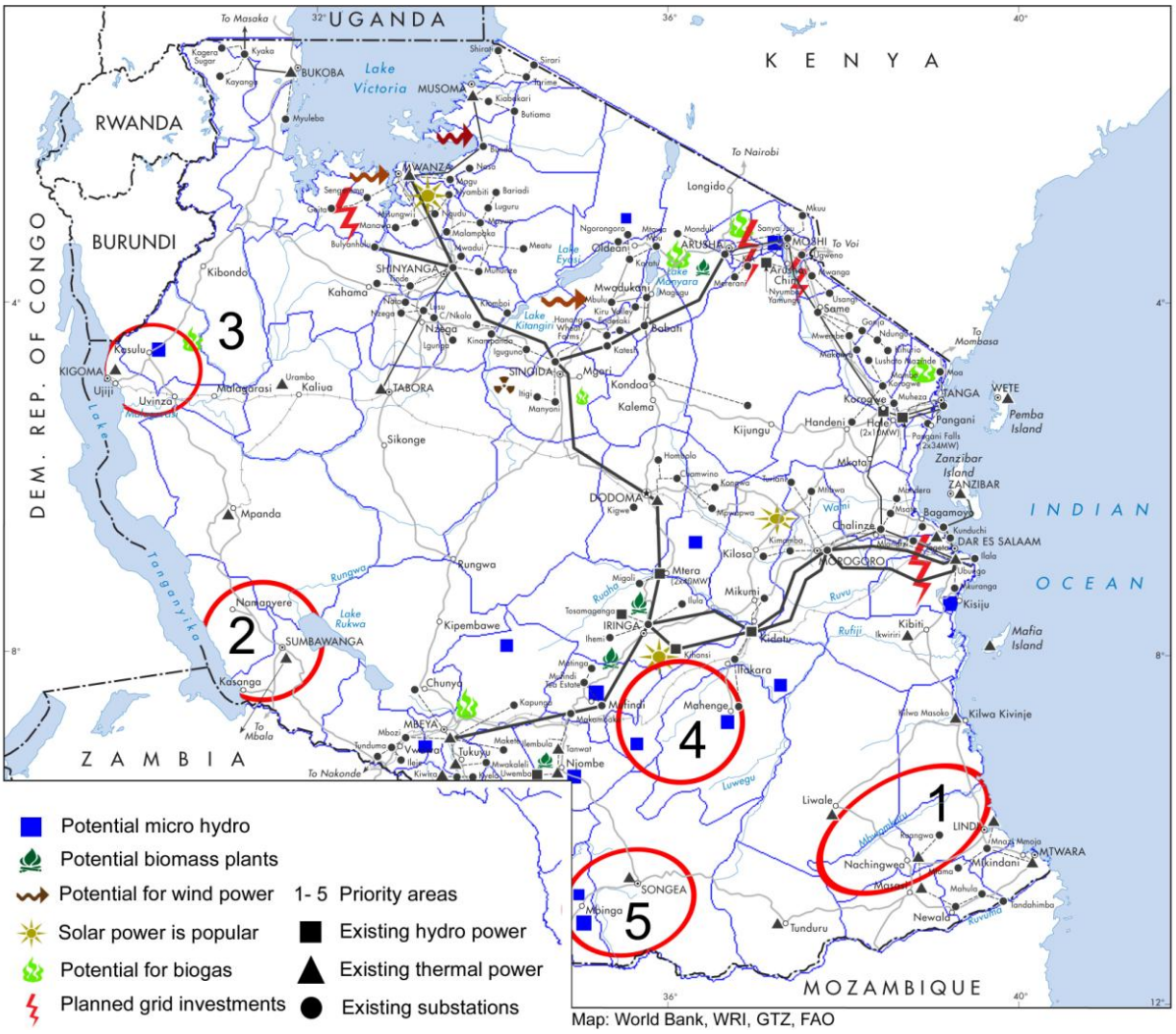
Table 2 There are at least five candidate regions for the development of rural green mini-grids in Tanzania

Number	Region	Districts	No. of villages	No. of households	Load demand
1	Lindi	Lindi Rural, Nachingwea and Ruangwa	14 villages	27,500	1.6 MW
2	Rukwa	Sumbawanga and Nkasi	3 towns + 5 villages	26,700	1.5 MW
3	Kigoma	Kigoma and Kasulu	3 towns	20,000	1.6 MW
4	Iringa	Kilolo and Iringa Rural	4 villages	12,800	600 kW
5	Ruvuma	Mbinga, Songea Rural and Namtumbo	3 towns + 4 villages	22,500	1.2 MW

Source: Tanzania Rural Electrification Study

The map below demonstrates the location of these areas in Tanzania. It shows that they are all areas that are situated a long way from the current grid. The map also shows the distribution of the potential renewable sources in Tanzania.

Figure 2 The five candidate regions for mini-grid development in Tanzania are a long way from the main grid



Source: World Bank, WRI, GTZ and FAO

3 The regulatory context

In relation to green mini-grids, there have been a number of important regulatory developments in Tanzania in recent years. They have improved the business environment for renewables and influence whether and where further AMC interventions may be required.

The desirability of private sector investment in renewable technologies has been acknowledged. The 2003 National Energy Policy states: '*It is necessary to encourage private investment in development projects, based on a rational exploitation and management of resources, and protection of the environment. Security of electricity supply needs to be enhanced through utilization of other local energy sources, including coal, natural gas, renewable energy and from regional grid interconnections ... There is a need to create a legal framework for renewable energy development and to establish an institutional structure and mechanisms to address technical, social and financial barriers for the dissemination of renewable energy technologies*'.

Special attention has been given to rural electrification. In 2006, the Tanzanian Rural Energy Agency was established. Its goal is to promote, facilitate, and improve access to modern energy for social and productive use in rural areas. To achieve these goals, it can provide grants and subsidy finance from the Rural Energy Fund. This is a fund generated by fiscal contributions from the Tanzanian government, levies on customers and international donors.

The confluence of these developments has led to two specific initiatives of importance: the creation of standardised power-purchase agreements and the Tanzanian Energy Development and Access Extension Project (TEDAP).

3.1 Standardised Power Purchase Agreements and associated regulatory policies

In February 2009, a standardised power purchase agreements (SPPAs) and associated standardised power purchase tariffs (SPPTs) for renewable power producers (with a capacity of less than 10 MW) selling power to isolated mini-grids were approved. At present, and for the foreseeable future, the only mini-grid operator that is likely to purchase power from third parties will be TANESCO that owns around ten diesel generators with town-size grid networks in rural Tanzania. To date, one such power purchase agreement for mini-grid supply has been signed with electricity due to be generated from biomass.

The standardised agreements define a formula for assessing the price at which power generated from renewable sources (with a capacity of less than 10 MW) can be sold to isolated mini-grids. The formula is used to determine the price in the first year of a contract. The formula is then applied in subsequent years subject to a floor and ceiling. The floor is the price in the year that the contract is signed, i.e. the price cannot be lower than the price in the year in which the contract is signed. The ceiling is 1.5 times the price in the year that the contract is signed, adjusted for inflation.[15]

The formula is based on the avoided costs from not producing electricity from conventional fossil fuel sources. An average is taken of the short run and long run avoided costs. The short run avoided costs are the costs saved from not having to produce power for the mini-grid from diesel generators in that year, including an annuitised capital cost element. The long-run avoided costs are the costs of conventional electricity generation that will not have to be incurred in the event that the mini-grid becomes connected to the main grid. This component of the calculation reflects a presumption that, eventually, there will be grid extension to all parts of rural Tanzania. In 2009, the formula led to a price of 335 TZs/kWh, equivalent to about 25USc/kWh using February 2010

[15] There is no adjustment for inflation in the floor price.

exchange rates.

The agreements also specify that generators of renewable electricity are 'must-take' facilities. This means that the wholesale purchaser of electricity (the Distribution Network Operator or DNO) must purchase all electricity that is produced by these generators.

The increased certainty that SPPAs provide for rural electrification projects in Tanzania compares well with other countries in East Africa. Although Kenya has a national feed-in tariff policy the provisions are only valid for electricity generation that is distributed through the main grid.[16] This reflects that the Rural Electrification Master Plan in Kenya is heavily focused on grid extension and the fact that the Kenyan grid operator KPLC is profitable, whereas TANESCO has severe financial difficulties that deter investors. In Rwanda bureaucracy and government interference in setting end-user tariffs has so far prohibited any developments of independent power producers or distributors apart from individual diesel generator sets.[17]

Complementary regulatory arrangements have also been put in place for renewable power sold to the main grid. For renewable generators connecting to the main TANESCO grid, the arrangements/methodology is very similar, although the formula implies a lower tariff (on average[18] 100 TZs/kWh, equivalent to about 7.6USc/kWh using February 2010 exchange rates).

Regulatory provisions for the direct sale of electricity to consumers in isolated regions have been established. In cases where renewable generated

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[16] The tariffs vary between 4.5-12 US cents per kWh depending on technology and consistency of supply.

[17] Angel-Urdinola, D., Cosgrove-Davies, M. and Wodon, Q. (2006), Rwanda: Electricity Tariff Reform, in Poverty and Social Impact Analysis of Reform, Coudouel, A., Dani, A. and Paternostro, S. (eds.), World Bank, Washington D.C.

[18] There is seasonal variation with a higher price between August and November (the dry season) and a lower price for the rest of the year.

power is sold directly to final consumers the provisions allow for the renewable generators to propose a cost based tariff to the Rural Energy Agency (REA) and EWURA (regulator) which, if approved by both, can then be levied on consumers.

3.2 Tanzanian Energy Development and Access Extension Project (TEDAP)

The Tanzanian Energy Development and Access Extension Project is intended to increase the electricity access in rural and peri-urban Tanzania. The project is being implemented by the Ministry of Energy and Minerals in collaboration with TANESCO and the REA. It is Funded by the World Bank and the Global Environment Facility (GEF) and running from April 2008 to June 2012. The overall programme has three components:

- Component A: To support generation and distribution investments by TANESCO
- Component B: To develop, test and demonstrate new rural electrification approaches
- Component C: To provide sectoral technical assistance

One of the aims of the programme is to encourage rural connections to mini-grids. As part of component B a performance grant for distribution of about US$ 500 is available for each connection made in rural areas. Competition for subsidies is open to all technologies (grid, offgrid, conventional and renewable), although the GEF grant can only be used for renewables. In addition to the performance grants, the programme provides support for market development and feasibility studies. The budget is targeted to provide nine grid-connected or isolated mini-grids of 4 MW in total, reaching 5,000 customers.

3.3 Implications for AMC design

Rural electrification in Tanzania through mini-grids is already proceeding using policies that are, or resemble, AMCs. The standardised tariff agreements for the supply of electricity to rural mini-grids make the supply of

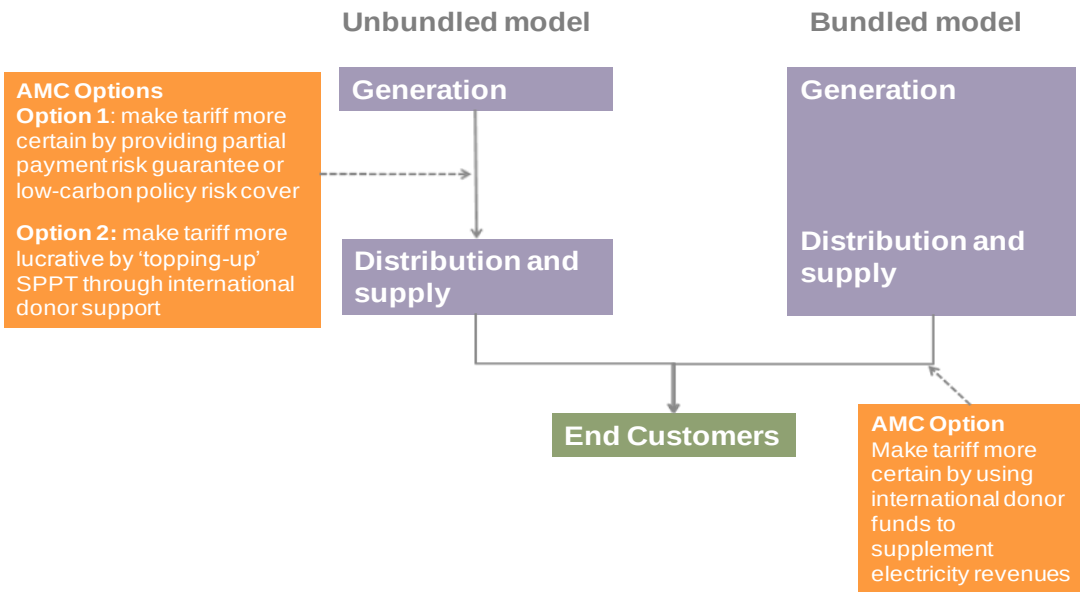
renewably generated electricity more lucrative and more certain than they were before the policy was introduced i.e. they fulfil the definition of an AMC developed in the theory paper. Furthermore, the use of a price based AMC is likely to be appropriate in this context given the demand uncertainty for renewably generated electricity at mini-grid sites. Likewise, the performance grant of US$500 per rural connection to renewable energy sources can also be interpreted as a policy that increases the revenues from making these connections, and makes them more certain.

The existing recognition of the benefits of AMCs in promoting rural electrification suggests that it would be a receptive context for further, appropriately designed, AMCs. However, it also suggests that care needs to be taken to ensure that any further policy interventions build upon the existing policy framework.

4 What role for (further) AMC options?

There are opportunities for AMC style solutions to promote further growth in green mini-grids in Tanzania at various stages of the mini-grid supply chain. Two generic options can be distinguished, depending on whether the power generator is distinct from the company responsible for the distribution and supply of electricity ('unbundled' model) or whether all activities are undertaken by an integrated company ('bundled' model). See Figure 3. The former case is more likely to be relevant in trying to encourage the switch from diesel generation to renewable generation at the existing (TANESCO owned) mini-grids. The latter case is likely to be more relevant in encouraging the development of new mini-grids.

Figure 3 There are various options for AMC interventions to support the existing regulatory and commercial framework for green mini-grids in Tanzania



Source: Vivid Economics

In both cases the potential AMCs consist mainly of providing further support, or a means of enhancing the existing regulatory and commercial framework

4.1 Using AMCs to encourage the sale of renewably generated power to mini-grids

There are opportunities to use AMCs to further strengthen the regulatory provisions surrounding the sale of renewable power to mini-grids. As discussed above, the Tanzania regulatory policy for selling power to mini-grids already resembles an AMC. Further interventions may be desirable to strengthen the effectiveness of these policies. Options exist both to make the arrangements more certain and more lucrative.

4.1.1 Making the existing policy more certain

There is a perceived risk that mini-grid operators (i.e. TANESCO) will fail to pay the standardised power purchase tariff, or that payments will be significantly delayed. Project developers fear that, even though the regulatory provisions state that a certain price must be paid, and have provisions in the event that this payment is not made, the operator of the isolated mini-grid (TANESCO in the immediate future) may not always make the payments on time. This may, in part, reflect previous experience of TANESCO when purchasing power from independent power producers.[19] It also reflects the fact that the standardised tariff will be considerably higher than retail price paid by the local community and hence will only be met through cross-subsidies from elsewhere in TANESCO's operations, at a time when TANESCO remains

[19] The IPP negotiated between TANESCO and Independent Power Tanzania Limited (IPTL) went to arbitration at the International Centre for the Settlement of Investment Disputes (ICSID) with both parties arguing that the other had breached its contractual obligations. In 2001, ICSID found that IPTL had not failed to fulfil a condition preceding TANESCO's assumptions of obligations but that IPTL had failed to incur some costs reasonably. A case concerning the interpretation of this ruling was launched by IPTL in 2008 which claimed that it was owed TZS 84 billion in capacity charges. The interpretation case is still pending.

financially weak.

An AMC could be used to mitigate this risk by providing a partial payment risk guarantee. This would provide greater certainty over revenue streams by agreeing, in the event of non-payment by the mini-grid operator, to make good some of the arrears. It would be prudent for only a partial guarantee to be provided in order to maintain incentives for the power producer and the mini-grid operator to establish a well functioning commercial relationship.

A more fundamental concern is the fear that the entire policy may be reappraised. If problems in paying renewable power producers became widespread then this could lead to pressure to re-evaluate the entire policy. Recognising this possibility, investors may be wary of committing capital to renewable power generation in the first place. A recent report by UNEP and partners[20] identified the risk of changes in the policy environment as one of the key risks preventing private sector engagement in low-carbon projects in the developing world. This has also been a key problem for private sector participation in electricity generation more generally.

An AMC could be provided in the form of a low-carbon policy risk guarantee. Donors could provide a guarantee to continue to make payments to power producers in the event that the current policy regime was altered unfavourably. A guarantee of this form could be extended to also apply to renewable electricity sold to the main grid.[21] Donors would work to control their exposure to this risk by liaising with the Tanzanian government and regulator. This echoes the proposal in the UNEP & partners report to overcome this barrier and would represent one of the first examples of this type of insurance policy being offered. The design of this policy would need to be undertaken carefully to ensure that the decision making process used to define

[20] UNEP & Partners (2009) 'Catalysing low-carbon growth in developing countries: public finance mechanisms to scale up private sector investment in low-carbon solutions' October.

[21] This may be particularly valuable for investors had established an integrated mini-grid operation close to the main grid and were exporting surplus electricity to the main grid.

an 'unfavourable' change in the policy regime was predictable.

As the regulatory framework becomes better-established and more credible the need for these insurance policies may fall away. This intervention may only be needed temporarily, until the regulatory framework becomes sufficiently well-established to provide investors with the necessary confidence. This is, at a broad level, the experience of the Multilateral Investment Guarantee Agency (MIGA) of the World Bank providing the related product of political risk insurance: a MIGA guarantee has a 67% probability of being cancelled or terminated before reaching expiry which is almost exclusively explained by a reappraisal of the need for the guarantee following the initial investment.[22]

4.1.2 Making the existing policy more lucrative

Alternatively, or in addition, international donors could structure funds through an AMC to increase the tariff received by renewable power producers. Although there are concerns that the price in the SPPT may be too high for TANESCO or other DNOs, for reasons explained below it may be desirable to increase the price further. The difference could be paid by international donors and structured as an AMC. Two possibilities could be considered.

The AMC could top up the SPPT in the event that diesel price becomes 'too low'. The standardised tariff is not based on an estimate of the costs of renewables generation in Tanzania but instead on the avoided cost of not having to produce power from alternative sources. A significant component of these avoided costs are the cost of diesel generation and hence the cost of diesel fuel. This means that if the diesel price was to fall then the tariff available under the standardised tariff arrangements would also fall for new projects (for pre-existing projects, the arrangements ensure that the price will not fall below

[22] Only 5% of policies are cancelled due to the financial difficulties or the investor switching to another political risk insurer. Independent Evaluation Group (2009) 'The World Bank Group Guarantee Instruments, 1990-2007'.

the price in the year the agreement is signed). For example, the current standardised tariff works out at around US$0.25/kWh. If the policy had been in place in 2000, and all other elements of the calculation remained the same, apart from the diesel price and the US:Tanzania exchange rate, then the formula would have provided a tariff of approximately US$0.11/kWh. At this tariff, renewables investment would be much less attractive (see Table 1 above). This is particularly pertinent given that there has been government and regulatory focus on ways of reducing diesel prices in Tanzania.[23]

Donor funds could be used to 'top-up' the price under the SPPT in the event that diesel prices fell below a certain threshold, which could differ depending on the renewable technology. If suitably calibrated the top-up could be justified in terms of international donors paying for the environmental benefits from renewable power generation in Tanzania, while TANESCO would continue to pay no more than for the conventional diesel alternative. This intervention would be temporary in the sense that it would only apply in the years that the diesel prices fell below the threshold specified. Additionally, the threshold diesel price at which additional support was provided could fall over time (making it less likely that support was provided) if greater renewable deployment resulted in lower costs.

The AMC could undertake the calculation assuming that the only counterfactual is diesel generation on a mini-grid. At present, the SPPT is calculated as a weighted average of the costs saved by not needing to use a diesel generator on the mini grid and the costs that will be saved when the mini-grid becomes connected to the main grid but less generating capacity is needed. This latter part of the calculation is justified on the basis that all mini-grids are intended to be connected to the main grid in the future. However, incorporating this second element into the calculation depresses the price received by renewable power generators. If this element was excluded from the tariff it would be closer to US$0.45/kWh rather than US$0.25/kWh. An AMC

[23] China Economic Net 'Tanzania to control fuel prices through state indicative pricing', January http://en.ce.cn/World/biz/200901/02/t20090102_17854847.shtml

could be used to pay the difference between these two values. This could be justified on the basis that, notwithstanding stated policy objectives, the grid connection remains an unlikely prospect for the foreseeable future in many of the regions where mini-grids are most attractive. However, it is likely to be desirable to scale back, or remove, this additional support over time as it would imply a tariff towards the top-end of the Tanzanian renewable generation costs identified in Table 1. This scaling-back could coincide with grid connection becoming more widespread throughout Tanzania.

4.2 Using AMCs to establish integrated mini-grid operators

The solutions above are unlikely to incentivise the creation of new mini-grids. Rather, they are options that would make it more attractive to sell renewable generated power rather than diesel generated power to existing mini-grid operations owned by TANESCO. They do not provide an incentive for the construction of new mini-grids. As such, they will have limited impact in improving electrification rates in Tanzania. To achieve this, new mini-grid operations are required.

For the foreseeable future, any potential new mini-grid operators are likely to wish to remain integrated between generation and distribution and supply.[24] Discussions with investors and project developers have revealed a strong preference for this business model in the short to medium term as the small scale of mini-grid operations in Tanzania mean that a vertically separated model would create considerable transaction costs. Unbundling between generation and distribution and supply would also means that the development of skills would need to be undertaken across a greater number of companies.[25]

[24] As well as, in the case of electricity generated from biomass, the biomass feedstock.

[25] In the longer term, some stakeholders have noted the possibility of unbundling between generation and distribution and supply with the integration of (distribution and) supply activities

The current regulatory arrangements provide for such integrated mini-grid operators to set a cost-based tariff for recovering costs from consumers. As these costs are likely to be higher than the willingness to pay of the local community, the REA makes grants available to developers so that the costs that need to be recovered from the local community are reduced.

Exclusive use of grants to bridge the gap between costs and local community willingness to pay creates a number of problems. These include the possibility that grants are paid to projects that never successfully develop electricity or the companies that are successful in acquiring grants are not necessarily those that have the most innovative or cost effective technical solutions (and rather are those most effective at acquiring grants from the REA). .

An AMC could have a role to play. An alternative approach would be to use an AMC, in part, to bridge the gap between costs and local community willingness to pay. All costs would only be recovered when electricity was actually sold to the local community. The price of electricity would consist of two components:

— A component paid by the local community, which could, for instance, be set at an amount equal to the TANESCO national low use tariff.
— A component paid by international donors, which would top-up this amount to a pre-defined maximum. One attractive option would be to calibrate this maximum amount to the standardised power purchase tariff paid to those supplying wholesale electricity to existing rural mini-grids (plus a further allowance for distribution and supply costs). This would ensure that the revenues available from establishing new

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across electricity, mobile telephony and micro-finance potentially representing an attractive business model. However, for this to be feasible, there will first need to be a scale-up of the number of mini-grids in Tanzania which, for the reasons outlined above, is most likely to be achieved through integrated companies.

green mini-grids would be broadly comparable to supplying power to existing mini-grid operations. It would also be an intervention that would be aligned to the existing regulatory framework.

This would look very similar to the pneumococcal AMC. In both cases, international donor commitments would be used to supplement the revenues available from end-users in order to ensure that developers had a reasonable expectation that capital costs would be recovered.

This would overcome the problems associated with exclusive reliance on grants but would create other challenges. A combination of grants and an AMC may be optimal. By only ensuring that international donor money was used if the mini-grid supplied electricity to the local community, this intervention would overcome the problems associated with providing grant support identified above. However, it would mean that a greater proportion of the finance for the upfront cost of a project would need to be found from capital markets. This, in itself, may be challenging but these problems would be compounded if the commitment was not sufficiently credible. Any particular investment support would need international donor support over a sufficient number of years to allow capital costs to be recovered. This could be very difficult for international donors to sustain, the realisation of which would raise the cost of capital.[26] Given these challenges, and acknowledging the existing availability of grants, it may be that a mixture of upfront grants and an AMC solution would be needed. The balance between these two support mechanisms could alter over time: in the near term, when perceived risks of mini-grid investments are high, making capital market access difficult, the bulk of the support could come from capital grants with AMCs making a smaller contribution. When experience is gained, AMCs could become the dominant form of support.

Although support for any one investment may need to be long-lived, there is

[26] This could be partly mitigated if the international donors providing the AMC were also responsible for providing (concessional) finance for the projects e.g. through credit lines.

some scope for believing that the programme could be temporary or, at least, scaled back over time. Although specific investments would require support for a sustained period of time, there is optimism that the programme (for new investments) could be scaled back over time. If the maximum price supported by the AMC was calibrated to the standardised power purchase tariff (SPPT) paid to wholesale providers of renewable electricity to mini-grids then this would imply a partial link to the costs of diesel generation for mini-grids. As the ESMAP analysis discussed earlier showed, these are often significantly greater than renewable generation costs. Consequently, if early initiatives demonstrated proof of concept then this may allow subsequent projects to be supported with support at a lower level. Pre-announcement of the intention to lower the level of support available for future investments would also have the attractive feature of incentivising early deployment.

5 Complementary policies

To be effective AMCs need to be accompanied by other policies to address the weaknesses on the supply side. One of the largest barriers to establishing green mini-grids in rural Tanzania remains the small number of private sector developers with the capacity to undertake such developments. A significant amount of capacity building is needed if the supply side is to be able to respond to the 'pull' created or enhanced by an AMC.

Policies are needed to tackle the barriers in the early stages of project development. There is a major challenge for developers in financing the first stage of project development. Access to finance to conduct feasibility studies and develop business plans to attract investors is slowing down the rate of scale up of rural electrification. Matching grants of up to 50% are available under TEDAP but even with this support developers need help accessing the remaining financing required.

Additional grant or contingent grant funding could be used to finance feasibility studies in order to establish the technical feasibility and financial viability of potential mini-grid sites. The TEDAP provides US$ 2.2 million for financing pre-investment and market development grants, which is unlikely to be sufficient for a large scale up of rural electrification through mini-grids given the costs of individual projects of US$ 1-9 million.

Business plan development for the construction and operation of green mini-grids will need to be supported. Often local entrepreneurs do not fully appreciate investor requirements in terms of solid business plans and budget calculations. Business advisory services and capacity building grants to help them develop these skills can leverage much larger amounts of private investments in these companies once a solid business plan has been developed

and links to banks and investors are established.

Local banks should be supported and encouraged to include energy loans in their portfolios. Access to finance for energy entrepreneurs is limited. In part this is due to a lack of knowledge by local banks about investments in the energy sector, although several local commercial banks have shown interest. The short tenors on offer in the Tanzanian financial sector are a particular problem for renewable energy projects, which typically require longer-term funding (e.g. 10-15 years) due to their relatively high upfront costs. The World Bank, through the TEDAP programme, is currently negotiating a credit line of US$ 25m for banks to on-lend to renewable energy projects. This may help to alleviate these problems.