

# Power to the People

Policy options to attract investment in off-grid renewable energy in Tanzania



**Climate Parliament**  
Legislators working worldwide to combat climate change



British  
High Commission  
Dar es Salaam





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Policy options to attract investment in off-grid renewable energy in Tanzania

A policy briefing from the **Climate Parliament** and **African Solar Designs**

Made possible by the support of **British High Commission Tanzania**

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# Table of Contents

|  |    |
|--|----|
| Abbreviations .....  | 5  |
| <b>1: Executive Summary</b>  | 6  |
| 1.1 Mini-Grids .....   | 7  |
| 1.2 Stand-alone systems .....                                      | 7  |
| 1.3 The role of renewable energy .....                             | 8  |
| <i>Key Recommendations for Parliamentarians</i> .....              | 9  |
| <br>   |    |
| <b>2: Off-grid energy in Tanzania</b>                              | 12 |
| 2.1 Electricity access .....                                       | 13 |
| <br>   |    |
| <b>3: The role of renewables</b>                                   | 18 |
| <i>Renewable energy technologies: a user's guide</i> .....         | 20 |
| <br>   |    |
| <b>4: National strategies for off-grid electrification</b>         | 23 |
| 4.1 Mini-grid electrification strategies .....                     | 24 |
| 4.2 Stand-alone electrification strategies .....                   | 27 |
| <br>   |    |
| <b>5: Institutional and policy frameworks</b>                      | 32 |
| 5.1 Policy & Legislative overview .....                            | 32 |
| 5.2 On-grid electrification policy & regulatory framework .....    | 34 |
| 5.3 Off-grid electrification policy and regulatory framework ..... | 35 |
| <br>   |    |
| <b>6: Recommended Policy Options for Off-Grid Renewables</b>       | 43 |
| <br>   |    |
| <b>Bibliography</b> .....  | 50 |
| <b>Annex 1: Case Studies</b> .....                                 | 52 |
| <b>Annex 2: Glossary</b> .....                                     | 55 |

## Abbreviations

|         |   |
|---------|---|
| AC      | Alternating Current                                       |
| ACP-EU  | Africa Caribbean Pacific - European Union                 |
| BEST    | Biomass Energy Strategy Tanzania                          |
| BMZ     | Federal Ministry for Economic Cooperation and Development |
| CNG     | Compressed Natural Gas                                    |
| DC      | Direct Current  |
| DfID    | Department for International Development                  |
| EU      | European Union  |
| EWURA   | Energy and Water Utilities Regulatory Authority           |
| GMG     | Green Mini-grids  |
| IPP     | Independent Power Producer                                |
| LPG     | Liquid Petroleum Gas                                      |
| MEM     | Ministry of Energy and Minerals                           |
| NGO     | Nongovernmental Organization                              |
| NORAD   | Norwegian Agency for Development Cooperation              |
| PPP     | Public Private Partnership                                |
| PV      | Photovoltaic  |
| REA     | Rural Energy Agency                                       |
| REB     | Rural Energy Board  |
| REF     | Renewable Energy Fund                                     |
| SHS     | Solar Home System   |
| SIDA    | Swedish International Development Cooperation Agency      |
| SNV     | Netherlands Development Organization                      |
| SPP     | Small Power Producer                                      |
| SPPA    | Standardised Power Purchase Agreement                     |
| SPPT    | Standardised Power Purchase Tariff                        |
| SREP    | Scaling-Up Renewable Energy Programme                     |
| TANESCO | Tanzania Electricity Supply Company Limited               |
| TANWAT  | Tanganyika Wattle Company                                 |
| TAREA   | Tanzania Renewable Energy Association                     |
| TDV     | Tanzania Development Vision                               |
| TEDAP   | Tanzania Energy Development & Access Programme            |
| UNDP    | United Nations Development Programme                      |
| URT     | United Republic of Tanzania                               |
| VSPP    | Very Small Power Producers                                |

## Section 1: Executive Summary

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Tanzania is severely threatened by climate change, yet it is rich in renewable energy resources that can be harnessed to drive development, create skilled jobs, and ensure access to clean, reliable energy for all. The wealth of solar, wind, geothermal and biomass energy which Tanzania receives is a valuable natural commodity, which could be used to power areas long affected by energy poverty, reduce reliance on price-volatile fossil fuel imports, and grow local renewable industries. To make all of this possible, informed leadership, ambitious policies and long term commitment are required.

**The objective of this study is to provide Tanzanian MPs with strategic policy recommendations that can help to foster investment in off-grid renewable energy in Tanzania.** Its findings can be summarised as follows:

**Electricity accessibility:** With access at about 21% of the population in 2014, Tanzania is among the countries with the lowest per capita connectivity to electricity. Of rural households, which make up over 80% of the total population, only 7% have electric connections.

A growing portion of the off-grid population obtains electricity through stand-alone solar photovoltaic (PV), pico-solar systems and mini-grids. TANESCO operates 20 diesel-based mini-grids, while 13 communities are powered by small-hydro mini grids, and many households use solar home systems (SHS).

**Targets:** The Tanzania government targets reaching 30% electricity access by the end of 2015, 50% by 2020 and more than 75% by 2033. The targets are ambitious, but unlikely to be achieved. They require significant investment in generation, transmission and distribution systems, and the upcoming budget allocation is not sufficient to enable a 9% increase – let alone the enormous mobilisation of human and logistical resources that would be required in a very short timeframe.

**How can Tanzania improve electricity access?** In the short term:

- 48% of the population can be reached by grid extension;
- 20% can be served through **renewable mini-grids**; and
- 32% can be served by **stand-alone renewable solutions**.

Each of these electrification strategies has a crucial role to play, and each requires a different approach.

## 1.1 Mini-Grids

A mini-grid is a self-contained electricity generation and distribution system where power is generated and then fed into a distribution network. Mini-grids are typically off-grid, less than 1MW in capacity, and utilize diesel, renewable or hybrid (combined) fuel sources to produce power.

Over 30 mini-grids in Tanzania are already in place. Historically, they have been diesel powered, but in recent years, policies that encourage the use of renewable sources have led to the establishment of a number of hydro and biomass-powered mini-grids. Though a robust regulatory framework is in place for mini-grids, the over-arching support for this approach – the budget allocation, in particular – does not enable them to develop.



Tanzanian regulation supports mini-grids in a range of ways:

- A Small Power Producer (SPP) program that provides a legal basis for Independent Power Producers (IPPs) to develop mini-grids;
- Preferential renewable energy Feed-in Tariff (FiT) for SPPs;
- Simplified permitting, registration and licensing processes for setting up an IPP and selling electricity, such as licensing and approval exemptions for small projects;
- Support for cost-recovering tariffs, which requires private developers to be commercial sustainable;
- Standardised Power Purchase Agreements (SPPAs), which provide a 'template' alternative for smaller players to avoid a potentially costly process of negotiating power purchase tariffs and terms with TANESCO;
- Technical guidelines for connecting to the grid;
- Tax breaks and subsidies including for connection costs, import of renewable energy equipment, project development.

## 1.2 Stand-alone systems

Stand-alone systems are electricity generation systems installed directly at an end-user's premises without any distribution network. Renewable energy powered stand-alone systems include solar PV, wind or hybrids of several technologies – the most prevalent being pico-solar (e.g. lanterns) and solar home systems.

Deep penetration of solar PV products into rural markets has significantly increased access to lighting and basic power for over 4% of Tanzanian households. Scores of Tanzanian companies are involved in the solar sector, and the commercial market for stand-alone systems in Tanzania is valued at several tens of millions of US dollars.

The regulatory framework is supportive of stand-alone renewable energy systems, and private actors do not need much further encouragement.

This said, there are several areas which could be improved through legislative or parliamentary action by MPs; these include:

- Need for quality standards for either equipment (at point of import) or installation (e.g. licensing for technicians).
- Protection of this price-sensitive market through tax, subsidy and/or microfinance support.

### 1.3 The role of renewable energy

Renewable energy technologies should play a primary role in Tanzania's future, for reasons including:

- Renewable 'fuels' such as sunlight and wind are abundant and free
- Technologies are available and costs have declined considerably
- Renewable technologies can be applied at the small, medium and large scale, and can power households and industries alike
- Growth of the renewable energy sector creates jobs and enhances value-addition in-country to other sectors of the economy.

Renewables already play a considerable role in Tanzania's electricity sector. Hydropower provides well over 50% of TANESCO's grid-based electricity; other technologies including biomass-generated electricity from wood and bagasse provide electricity on and off-grid. Solar PV powers hundreds of thousands of off-grid households and institutions.

Still, renewables besides large hydropower account for only about 4.9% of generation capacity despite Tanzania's abundance of renewable energy resources.



# Key Recommendations for Parliamentarians

*Policy options to stimulate private investment in off-grid renewable electricity*

**Get renewable energy on the public agenda.** Through the regular work of parliamentary debate and national discussion, MPs can push energy issues onto the public agenda. MPs should speak up and make sure these issues are heard, thus raising awareness, building public appetite for change, and developing political pressure.

**Legislate to create funds for energy access and renewably powered off-grid electrification.** The lack of off-grid electrification is rooted in a lack of sufficient established funding frameworks. Acts that establish institutions such as REA and EWURA must ensure their continuous funding, and Parliament must ensure that sources of funding evolve and improve with changing circumstances.

**Exercise parliamentary oversight and approve/amend government budgets.** Parliament may have limited input into the formation and definition of national budgets; but where possible, MPs can focus on creating a mandate and then ensuring that the mandate is carried out.

**Create a sound policy and legislative environment.** This should include:

**1. Committing to renewable energy at high level.** This includes:

- a. Finalise an ambitious but realistic national Renewable Energy Policy and Renewable Energy Strategy.
- b. Regulate and tax fossil fuels in accordance with a clear, consistent national policy to shift away from these energy sources.

**2. Committing to off-grid solutions as part of a strategic rural electrification approach.** This means:

- a. Allocating and then ring-fencing funding for off-grid solutions.
- b. Minimising political and last-minute uses for rural electrification funds.
- c. Recognising the importance of productive off-grid power.

**3. Ensuring TANESCO and the REA have the funding and structure to implement their mandate.** This includes:

- a. Assisting TANESCO in improving and ensuring its sound financial standing.
- b. Considering options for the partial decentralisation of REA, so as to enable direct action on regional off-grid projects.
- c. Supporting options for project developers and consumers to access financing and credit. These may include loan guarantees, educating local banks, matchmaking investors and financiers, addressing minimum equity constraints, facilitating consumer microfinance or microcredit schemes, etc.



## Key Recommendations for Parliamentarians

(continued)

**4. Working at the regional level within EAC and SADC Parliaments** (and other groups) to promote renewables.

**5. Balancing negative with positive incentives.** Advocacy and legislation to promote off-grid renewables must steer investors using both 'carrots' and 'sticks'. These include:

- a. VAT exemption for Renewable Energy technologies.
- b. Positive incentives for the use of renewables.
- c. Supporting the establishment of national solar PV quality equipment standards, based on regional (EAC) and international best practice.

The above recommendations offer an overview of actions Parliamentarians can take to stimulate investment in off-grid renewables in Tanzania. The basic framework is already there, and a model for other countries. **More than anything, what is needed is the political will to make Tanzania green and electrified – and the rest will come.**

*More than anything, what is needed is the political will to make Tanzania green and electrified – and the rest will come.*



A photograph of an elderly man with a white beard and hair, wearing a light pink long-sleeved shirt and dark trousers, standing in the doorway of a house. The house has a corrugated metal roof with a solar panel array mounted on it. The walls are made of reddish-brown mud or plaster. There are several large green plants in the foreground. The sky is clear and blue. A black banner with orange text is overlaid on the upper part of the image.

## Section 2: Off-Grid Energy in Tanzania

*Renewable energy is often a good fit for off-grid electricity needs, because it can be sized according to need and because the fuel sources - sun and wind - are plentiful and free.*

## Section 2: Off-grid energy in Tanzania

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The United Nation's *Sustainable Energy for All Initiative* defines **energy access** as access to both electricity and the services it provides for domestic use and clean cooking and heating systems. This includes access to productive energy, such as mechanical power that supports value-addition activities and income generation.

In this report we take a broader approach. The following sections consider off-grid energy as it relates both to the off-grid poor (productive access for households and small businesses) as well as the off-grid commercial sector (sufficient power for agriculture, industry, etc.). Institutional energy needs are also in the mix for public services such as education, health and political administration.

**Off-grid energy** includes both electricity and heat energy, the latter being by far the predominant form of energy used in rural areas in Tanzania, most often as wood or charcoal.

In national planning – and in the allocation of national budgets – funds are often disproportionately allocated for electricity, as the preferred ‘modern’ energy source for the population. As Tanzania struggles to address rapid depletion of biomass (mostly woodfuel) resources, we strongly urge government to continue action on improved woodfuel efficiency, alternative cooking and heating fuels and increased sustainable production of biomass.

In this report, **we focus on off-grid electricity**: electrical power that is obtained from something other than the main national electricity grid. In particular, we look at the intersection between improving off-grid electricity access and using renewable energy resources to do it.

Renewable energy is often a good fit for off-grid electricity needs, because the most common technologies are modular (ie: can be sized according to need) and because the ‘fuel’ resources – such as sun and wind – are plentiful and free.

## 2.1 Electricity access

### Connectivity and accessibility

With access at about 21% of the population in 2014, Tanzania is among the countries with the lowest per capita use of, and connectivity to, electricity. This said, data from the last decade shows impressive improvements in this area – Table 1 shows the 2012 figures, with a 17.8% total access rate that indicates strong progress in only 2 years. The table also provides an indication of the breakdown of sources of power for the population.

**Table 1: Electricity access as of end 2012**

| Source            | Urban | Rural | Total |
|-------------------|-------|-------|-------|
| TANESCO           | 30.0% | 2.1%  | 10.6% |
| Generator         | 3.5%  | 2.4%  | 2.8%  |
| Solar Home System | 3.5%  | 4.9%  | 4.5%  |
| Total             | 37.0% | 9.4%  | 17.8% |

*Source: Tanzania National Electrification Prospectus Programme*

Grid electricity is concentrated in urban areas, though even in urban areas only 39% of households have access. Of rural households, which make up over 80% of the total population, only 7% have electric connections.<sup>1</sup>

Despite this rapid expansion of access, most rural people still rely on kerosene and candles for lighting, dry cells for electricity, and wood and charcoal for cooking. A growing portion of the off-grid population obtains electricity through stand-alone solar photovoltaic (PV), pico-solar systems and mini-grids.<sup>2</sup> TANESCO operates 20 diesel-based mini grids, some of which are interconnected to neighbouring countries. Thirteen communities receive electricity from small-hydro mini grids, and many use privately procured or donor-supported solar home systems (SHS).<sup>3</sup>

Though electricity access is usually cited as a number of individual connections as a percentage of the total population, these figures can mask low usage rates, which may be due to low capacity to pay for kWh, unreliable power supply, a lack of productive applications for the power, or other issues. Increasingly, governments are looking at 'energy access' in a more holistic way, to address the need to provide citizens with sufficient, reliable, affordable and productive power.

<sup>1</sup> EWURA 2014

<sup>2</sup> German Energy Desk, *Target Market Study Tanzania: Solar PV & Wind Power*, 2013

<sup>3</sup> SREP 2013

## Electricity access strategy and targets

Under the “Electricity Supply Industry Reform Strategy and Roadmap 2014-2025”, the Tanzanian government has targeted 30% electricity access by 2015, 50% by 2020 and more than 75% by 2033. The strategy is aligned with Tanzania’s Development Vision (TDV) 2025 that envisages Tanzania’s pathway to becoming a middle-income country by 2025.<sup>4</sup>

The targets are ambitious, and unlikely to be achieved. They require significant investment in generation, transmission and distribution systems, and the upcoming budget allocation is not sufficient to enable a 9% increase to hit the 30% target by 2015, let alone the enormous mobilisation of human and logistical resources that would be required in such a short timeframe.

This said, targets serve different functions for a national government – it is good to be ambitious, if realistic mechanisms are put in place to advance the country toward these end goals. Tanzania’s plans to meet electrification access goals include the following reforms of the electricity sector:

- Improving TANESCO’s financial position
- Attracting private capital investment
- Reducing public expenditure on environment and social impact
- Increasing the availability, reliability, affordability and sustainability of electricity supply
- Increasing connection and access levels
- Diversifying sources of power generation
- Improving efficiency and electricity service delivery
- Reducing technical and non-technical system losses.

**Table 2: Rural energy access**

| Indicator               | 2004       | 2010       | 2015 projected |
|-------------------------|------------|------------|----------------|
| Projected population    | 34.5 M     | 40 M       | 43 M           |
| Rural portion           | 77%        | 60%        | 54%            |
| Rural population        | 25,907,011 | 23,929,425 | 23,140,456     |
| Average HH size         | 4.9        | 4.9        | 4.9            |
| Rural households        | 5,287,145  | 4,883,556  | 4,722,542      |
| Access to electricity   | 55,000     | 241,825,   | 752,717        |
| % access to electricity | 1%         | 5%         | 16%            |

*Source: Strategic Target for Rural Energy Agency and Fund*

<sup>4</sup> (Electricity Supply Industry Reform Strategy and Roadmap 2014 - 2025)

## How can Tanzania improve electricity access?

Tanzania's large size and widely dispersed rural population limit the role that extension of the main TANESCO grid can play in providing the entire population with minimal access to electricity. In the short term, it is simply too expensive to run power lines to a majority of the population.

In 2013, a rural electrification study was conducted by REA help identify the most viable rural electrification strategies and to delineate areas better suited for off-grid electrification, thus allowing REA to improve its electrification strategy. According to the Rural Electrification study (see Figure 1), in the short term:

- 48% of the overall population will best be reached by grid-based electrification initiatives.
- 20% of the population's needs can be met through mini-grids (most of which can be renewably powered)
- 32% of the population's electricity needs can be met with stand-alone solar PV and pico-grid solutions.<sup>1</sup>

As a result of the study, and years of accumulated experience, Tanzania is pursuing three integrated rural electrification strategies:

1. Grid extension of the TANESCO main grid;
2. Off-grid mini-grid systems for localities far from the main grid with sufficient demand; and
3. Support for stand-alone and distributed solutions.

Each of these electrification strategies has a crucial role to play, and each requires a different approach. As explained in the following sections, each of the three strategies also requires specific regulatory frameworks and funding approaches. Grid-based electrification initiatives have, to date, received a large portion of Tanzania's electrification resources. This is appropriate, because in the long term, grid extension will have the greatest impact in the most areas. Still, off-grid strategies – i.e. mini-grids and stand-alone systems – require more resources than they currently receive because, as shown in Figure 2, the TANESCO grid extensions simply cannot reach the entire country in the target period.

*52% of Tanzania's population can be electrified through renewable mini-grids or stand-alone solar PV and pico-grid solutions.*



1 AHK, Target Market Study Tanzania, Solar PV and Wind Power, 2013

## Tanzanian electricity access plans and initiatives



Compared to its East African neighbours, Tanzania's rural electrification policy environment is relatively progressive. It has liberalized electricity generation, and, in 1994, dismantled TANESCO's monopoly on generation, transmission and distribution. This partially paved the way for Independent Power Producers (IPPs) to generate electricity for sale to the grid and, later, into isolated mini-grids.

As a major step forward in improving electricity access, Tanzania developed a national electrification strategy to promote rural electrification. The Rural Electrification Agency (REA) became operational in 2007 following earlier national policy initiatives to promote and facilitate improved access to modern energy services in rural areas.

Together with the Rural Energy Fund (REF) and the Rural Energy Board (REB), REA facilitates access to modern energy services in rural areas. It supports public, civic and private entities with grants for capacity building, feasibility studies and capital investment. It also coordinates the work of international partners, who support components of the national electrification programmes.<sup>1</sup>

Tanzania is supportive of smaller decentralized projects and private or community-led initiatives, and formally recognizes the importance of off-grid renewables. The private sector at present, however, still lacks the capacity and funding required to intervene significantly to finance off-grid energy programmes at the scale required.

As such there are significant parts of the country that still lack access to energy and are far from the grid.<sup>2</sup>

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1 Ahlborg, H. Hammar, L. Drivers: *Barriers to Rural Electrification in Tanzania and Mozambique: Grid Extension, Off-grid and Renewable Energy Sources*, 2011

2 DFID, *Green Mini-Grids Africa :Options Assessment in Kenya and Tanzania*, 2013



## Section 3: The Role of Renewables in Off-Grid Energy





Renewables (excluding hydro) account for only about 4.9% of national generation capacity, despite Tanzania's abundance of renewable energy resources.

## Section 3: The role of renewables

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Renewables already play a considerable role in Tanzania's electricity sector. Hydropower, for example, provides well over 50% of TANESCO's grid-based electricity. Biomass-generated electricity from wood and bagasse (in the sugar sector) provides electricity for sawmills and sugar plantations alike – both on and off the national grid. Solar PV powers hundreds of thousands of off-grid households and institutions.

Still, renewables besides large hydropower account for only about 4.9% of national generation capacity, despite Tanzania's abundance of renewable energy resources. The government has set a target for the share of renewables in the energy mix to reach 14% by 2015.<sup>1</sup>

**Hydropower** is the most widely used renewable resource for electricity generation and commercial investment both globally<sup>2</sup> and in Tanzania. However, electricity from hydro sources is highly dependent on climate and weather fluctuations; arid periods when catchment areas for hydro facilities dry out can impact stability of supply. As such, in conversations about 'renewable energy' experts often separate out hydropower from other resources.

In Tanzania, large-scale hydropower projects (>10MW) meet over 35% of the country's on-grid base load, with 6 projects that generate 562 MW of electricity – just a fraction of the country's estimated 3800 MW potential.

Off-grid applications of hydropower involve smaller-scale projects (<10MW), for which there is substantial potential (in particular using mini-grids) and a number of projects already in existence (see section 4.2 below).<sup>3</sup>

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1 SREP 2013

2 Twidell, J. Weir, T. *Renewable Energy Resources*, 2006

3 E. Michael et al, *Increasing Sustainability of Rural Community Electricity Scheme: Case Study of Small Hydropower in Tanzania*, 2010

**Biomass** combustion for electricity generation. Tanzania already has 33 MW of cogeneration mainly in sugar and forest plantations (See case study below of the 4MW TANWAT biomass plant). The Tanzania National Electrification Prospectus has identified 310 villages, with a total population of about 1 million inhabitants, as potential candidates for electrification using biomass power. UNDP estimates that there is 315GWh/year of potential from biomass cogeneration potential in Tanzania.

**Biogas** for electricity generation. Industries and institutions with large amounts of animal or plant waste (i.e. dairies, sisal plantations, schools/prisons, etc) may be able to burn biogas in generators and feed this power into the TANESCO grid or mini-grids.

**Wind power** is the second most important large-scale source of renewable energy globally. In East Africa (Ethiopia and Kenya), wind projects in the hundreds of megawatts are currently being installed. Tanzania, like Kenya, has strong wind resources particularly in escarpment areas around the Rift Valley and along the coasts. Two grid-connected wind projects totalling 150MW are under development in Singida. In addition to the large grid-connected potential (which measures in the hundreds of MWs), there is some limited potential for wind in stand-alone and mini-grid applications.

**Solar photovoltaic** (PV) technology generates electricity from sunlight. SPV modules convert solar radiation into direct current (DC) electricity that is stored in batteries or is converted to alternating current (AC) electricity using an inverter. It is the fastest growing renewable energy in the world, with South Africa alone reaching 1000MW of installed SPV by 2015). In Tanzania, solar PV has a major role to play in off-grid electrification as well as for TANESCO-connected generation.

**Stand-alone systems** range in size from several watts (pico systems) to tens of kilowatts. Several hundred thousand solar home (SHS) and pico systems already power off-grid households. Larger institutional systems power schools, churches, water pumps, health centres and police posts. There is much more potential.

**PV-diesel hybrid mini-grids** have the potential to reduce or eliminate the use of diesel for mini-grids in hundreds of remote sites.

**Geothermal** power plants use steam produced from reservoirs of hot water found below the Earth's surface to produce electricity. The East African Rift Valley has tens of GW geothermal electricity potential. Kenya has developed over 300MW of geothermal. Tanzania's geothermal potential is over 650 MW. Virtually all of Tanzania geothermal potential will be grid-connected – as such we do not address its use further below.

# Renewable energy technologies: a user's guide

## Hydropower



**Mini-grid:** 22.5 MW installed, 31 MW under development. Scores of potential sites

**Stand alone:** Not viable except for large institutions (e.g. tea plantation)

**Pros:** 'Firm' (consistent) source of power; widely available resource; applicable at a range of system sizes and power levels, from very small to very large; mature technology

**Cons:** Location specific; considered by some to be a more questionable form of renewable energy, because of interruption to water ecosystems; seasonally variable, and will become more so with climate change impacts

## Wind



**Mini-grid:** Limited potential for use in combination with diesel generators or solar PV.

**Stand alone:** Limited potential in windy sites. Relatively expensive and complex.

**Pros:** Considered one of the cleanest forms of power; Tanzania has wind resources

**Cons:** Location specific; tends to be profitable only at larger scale; relatively expensive compared with other options

## Biomass



**Mini-grid:** Several projects already developed; +300 potential sites

**Stand alone:** Limited potential in off-grid institutions

**Pros:** Resources, for the most part, available across the country; inexpensive (or 'free') fuel source for combustion (if using agricultural waste); co-generation (production of both heat and electricity) has valuable applications for some off-grid industries

**Cons:** Only biomass waste (primarily from agricultural sector) is widely agreed to be 'renewable'; carbon emissions associated with direct combustion, less so with biogas; fuel resource can be seasonal or otherwise variable; may require aggregating from more than one site

## Solar Photovoltaic



**Mini-grid:** Used in conjunction with diesel generation or with batteries in small mini-grids. Hundreds of potential sites.

**Stand alone:** Extremely high potential: pico-solar, solar home systems, institutional systems.

**Pros:** Modular technology fits most size and price needs; cost for PV modules has dropped dramatically in last 5 years; can be used in conjunction with other energy sources, including diesel, to 'clean' existing off-grid power supply; strong private sector already distributing these technologies; resource abundant across Tanzania, not location-specific; local manufacture of some components possible (e.g. modules and batteries being made in Kenya)

**Cons:** Relies on a battery to store power for non-daylight hours, which adds costs and maintenance needs to a system; many privately supplied systems have poor quality parts and/or installation, resulting in high failure rate and negative consumer opinion; limited applications for higher power consumption activities, such as industry; costs highly vulnerable to national/regional taxation rules (VAT, import duty)



## Section 4: National Strategies for Off-Grid Electrification



*Renewables (excluding hydro) account for only about 4.9% of national generation capacity, despite Tanzania's abundance of renewable energy resources.*

## Section 4: National strategies for off-grid electrification

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This section presents an overview of Tanzanian programs for off-grid electrification. The estimated cost of electrifying 30% of the country is more than \$3.5 billion, or \$220m per year over 10 years.<sup>1</sup> This amount focuses almost entirely (nearly 90%) on grid extension, and full financial support for existing off-grid initiatives has yet to be realized (though the TEDAP and SREP programmes have identified initial funds and strategies, as described below).

### **Grid-based electrification strategies: the TANESCO grid**

The national utility, Tanzania Electricity Supply Company (TANESCO) is the main electricity generator and distributor. Independent power producers (IPPs) supply TANESCO – but it has a virtual monopoly on distribution. As of 2013, the installed capacity in the main grid was 1522MW, of which 562MW (37.4%) is hydro and 939MW (62.6%) is from thermal plants (see Table 9 below). This thermal power is comprised of 501MW gas and 438MW oil. Over recent years, the thermal proportion of the generation mix has been increasing due to reduction in hydro contribution caused by repeated drought.<sup>2</sup>

Tanzania has a number of IPP plants producing approximately 300MW. The government recognises that there is a need to promote private investment in electricity generation, transmission and distribution projects and is taking proactive steps to encourage this.<sup>3</sup> Grid-based electrification has been the focus of investment and is considered the

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<sup>1</sup> *Norad National Electrification Programme Prospectus*

<sup>2</sup> EWURA, 2014

<sup>3</sup> Norton Rose Fulbright, *“Investing in the African Electricity Sector: Tanzania-Ten Things to Know”*, 2013

least-cost solution in densely populated parts of the Tanzania mainland.<sup>4</sup> Given sufficient consumption and concentrated demand, it is usually the most economical electrification strategy. To assist low-income consumers, TANESCO subsidizes a “lifeline” tariff (very low flat rate) for those with very low consumption.

Some of the challenges facing grid extension, and the reasons why reaching over 50% of the population will be difficult in the short term are:

- A geographically dispersed population which is far from grid lines;
- Long distances between major loads which cannot be easily covered by transmission lines;
- Lack of generation capacity which means extension of the grid may not solve the problem;
- High technical losses;
- Lack of financial capital to invest in extensions and new capacity;
- Dependence on foreign financing and consultancy;
- Lack of private sector involvement;
- Political interference in power projects.

This report will focus on alternatives to grid extension: mini-grids and stand-alone systems.

## 4.1 Mini-grid electrification strategies



A mini-grid is a self-contained electricity generation and distribution system where power is generated and then fed into a distribution network that provides anywhere from 5 to 1,000 end-users with electricity in their premises. Mini-grids are typically off-grid, less than 1MW in capacity, and utilize diesel, renewable or hybrid (combined) fuel sources to produce power. When powered by either fully renewable or diesel-hybrid generation they are referred to as “green mini-grids” (GMGs). Smaller sized and capacity mini-grids (called “micro” or “pico” grids) can be used for smaller communities.

Mini-grids generally cost more per connection and per kWh than grid-based electrification. They are only feasible where there is a minimum level of demand from the community and where there is finance available to plan, install and operate them. More recently mini-grid developers have been looking at so-called “ABC” business models – whereby an **Anchor** consumer such as a larger institution or commercial entity agrees to off-

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<sup>4</sup> IED, *Definition of a Framework Programme for Interventions in the Energy and Power Sectors in Tanzania Under the 11th EDF National Indicative Programme*, 2013

take most of the load, and the remaining power is sold to nearby **Business** and **Community** consumers. This can allow the revenue model to be structured in a way that balances higher-consumption, higher capacity to pay consumers with others that may be less reliable.

Mini-grids are a key component of Tanzania's electrification strategy and often the most economically viable electrification option in remote areas where hydro/solar/biomass resources are available. The Rural Electrification Master Plan estimates that 20% of the rural population will be best electrified using mini-grids. Many mini-grids are developed in close collaboration with grid extension programs, and most are specifically reliant on feed-in tariffs from TANESCO. TANESCO, communities or private investors can own and operate mini-grid and various business models are supported by the REA.

Over 30 mini-grids in Tanzania are already in place, and the total capacity stands at 78MW (TANESCO). Historically, a majority of mini-grids have been diesel powered, but with policies that have encouraged renewable sources a number of hydro and biomass-powered mini-grids have been established. A pipeline of new projects has been initiated with the REA and private developers.

Tanzanian regulation supports both isolated off-grid mini-grids and mini-grids that connect into the TANESCO grid (which itself may be the main national grid or a TANESCO-operated large off-grid mini-grid). The regulator (EWURA) has laid out a framework that is among the most progressive in the region in support of private sector mini-grid development.

Primary barriers to off-grid electrification through mini-grids include:

- Lack of government budget allocation to support mini-grids – despite a positive regulatory framework
- Lack of viable business models, based on:
  - High capital expenditure costs – and difficulty sourcing financing from commercial banks or investors because of:
    - Lack of awareness of mini-grid and/or renewable energy project finance models within many lending institutions
    - Lack of confidence in TANESCO as an off-taker
- Uncertainty regarding procedures – and impact on revenue models – in the event a TANESCO grid extends to the site of an isolated mini-grid



## On-going mini-grid initiatives



The majority of off-grid electrification activities in Tanzania (both mini-grid and stand-alone) are supported by the REA under the Tanzania Energy Development & Access Programme (TEDAP). TEDAP is funded by the World Bank and Global Environmental Facility (TEDAP partners include the World Bank, Sida, Norad, the European Union, and DFID) and is designed to help develop off-grid and renewable energy projects in Tanzania. Over 10 years, the off-grid component has allocated \$22.5m to improve rural electricity access, promote mini-grids and stimulate small-scale solar market development in Tanzania.

The program has also built the capacity of the private sector in Tanzania to develop renewable energy projects. The programme has served as a long-term source of funds to financial institutions that lend to eligible rural or renewable energy projects, and is being administered by the Tanzania Investment Bank (TIB) on behalf of the Ministry of Finance under the direction of REA and the Bank of Tanzania (BoT).

Within TEDAP, government encouragement of private sector involvement has been particularly helpful. As of 2013, TANESCO had signed PPAs with 11 developers to supply 46 MW of power, as well as Letters of Intent with another six developers for a further 31 MW of power. Four sites are already in operation. However, the next phase of the TEDAP project will focus almost exclusively on grid extension, after limited success with building off-grid markets and preference by government for grid-based focus.

That said, Tanzania is now a pilot country selected to benefit from the “Scaling-Up Renewable Energy Programme” (SREP, a World Bank globally-promoted initiative). SREP’s objective is to model the economic, social and environmental viability of green projects in the energy sector, and is expected to follow the conclusion of TEDAP in 2015. It has earmarked funds for renewable mini- and micro-grids in the program jointly developed with REA. The project will offer transaction advisory services, financing and risk mitigation for 25 mini-grids and 50 micro grids. It also is allocating funds for stand-alone systems in specific remote areas.

*Over the last 10 years, the off-grid component of the TEDAP scheme has allocated \$22.5m to improve rural electricity access, promote mini-grids and stimulate small-scale solar market development in Tanzania.*

## 4.2 Stand-alone electrification strategies

**Stand-alone systems** are electricity generation systems installed directly at an end-user's premises without any distribution network. A diesel generator is one example of a widely used stand-alone system. Renewable energy-powered stand-alone systems include solar PV, wind or hybrids of several technologies. Stand-alone PV systems range in size from pico systems (<10W) to Solar Home Systems (SHS) (10-200W) to larger institutional systems, which can be over 50kW in size.

The REA Rural Electrification prospectus identifies 32% of the rural population as best electrified using stand-alone systems. Stand-alone systems are viable in low population density areas where there may not be major economic activities and where mini-grids are not economically viable. Though the Government recognizes the role of stand-alone PV systems in rural electrification, it does not allocate significant funding for the household market. Thus, to date, growth of household and small-business stand-alone PV markets has been primarily commercially driven, although the Government and donor-partners have, through some specific programmes (see below), supported programs to electrify institutions through stand-alone PV systems.

Deep penetration of products into rural markets has significantly increased access to lighting and cell phone power as over 4% of Tanzanian households are now solar powered. Scores of Tanzanian companies are involved in the solar businesses, and NGO and Government demand for institutional systems also contributes to the commercial market. The commercial market for stand-alone systems in Tanzania is valued in the tens of millions of US dollars.

The market for solar home systems and over-the-counter pico solar products has been growing rapidly. However, there are problems associated with this rapid growth. Low quality, low priced LED/PV kits (primarily from Asia) have flooded the market, with many of these products being short-lived and not meeting any minimum quality standards. Such so-called "fake" products sold to low-income rural people threaten the market, first because they lower the overall rural perception of solar products and secondly because they can represent lost investments by rural people whose ability to spend such amounts is extremely limited.

**PV Solar Home Systems.** SHS have been used in rural Tanzania since the 1980s to provide electricity for lighting and powering low power electrical appliances. They have the advantage of a relatively low initial investment cost, making them affordable to the rural population. They also help

replace kerosene use for lighting that is both expensive and unhealthy. Their main disadvantage is limited power capacity and a limited range of applications. Cumulative installed capacity of solar PV in Tanzania is estimated to have increased at least twenty fold between 2005 and 2012 to over 5 MW.<sup>5</sup>

Traditionally, SHS have been sold on a “cash for carry” basis. In other words, the consumer pays for the system in a single upfront payment (or, in a few cases, over time if financing is available). However, in East Africa there is growing business support for “fee for service” models that combine small initial registration payments with pre-payment for on-going usage using mobile phones (i.e mobile money). Under fee for service models, the supplier maintains ownership of the physical equipment and operates, in effect, as a “mini-utility”. Off-Grid Electric in Arusha has pioneered this model.

**Pico-Solar Systems.** Pico-solar product demand has increased rapidly all over East Africa because increased product availability and quality, donor support and massive market demand. Donor supported initiatives have supported quality products and subsidized social entrepreneurs to market products.

There is a considerable private sector market for pico-systems that is growing quickly. This has been actively supported by the IFC’s Lighting Africa program. Many initiatives are also being carried out by social entrepreneurs and NGOs seeking to lower the use of kerosene by rural households. SolarAid/SunnyMoney Tanzania’s solar pico project is a success story that has commercially sold more than 50,000 portable solar lights in 2012 alone.

The primary barriers to off-grid electrification through stand-alone systems include:

- High initial investment cost of systems, especially among low income households
- Limited power from solar pico and solar home systems, making grid connection always preferable
- Profusion of substandard products in shops which spoil the market and dent consumer demand
- Expensive last-mile distribution.

## On-going stand-alone initiatives

The national electrification prospectus identifies both SHS and pico-solar systems as viable options for rural electrification, and the government (with partners including USAID, NORAD, SIDA, the EU and BMZ) has indicated that it will continue to support REA in promoting solar energy use in off-grid areas.

A number of government or donor initiatives to promote the use of solar PV in rural electrification are already on-going or completed:

- The Sida/MEM Solar PV Project, a national energy project funded by the Swedish International Development Agency (Sida) through the Ministry of Energy and Minerals (MEM), built up commercial supply channels and rural installation capacity between 2006-2011.
- The World Bank TEDAP (see mini-grid section above), REA and other bilateral programs support the execution of institutional PV systems and SHS electrification objectives in the short term (AHK, Solar PV and Wind Target Market Study, 2013). Household stand-alone market development is expected to continue to be built on a commercial basis (possibly with Result-Based Financing fostering market development).
- The Sustainable Solar Market Packages (SSMP) will be launched by REA in the second phase of TEDAP/SREP, in an effort to provide sizable contracts to companies in target regions so that they can install a minimum number of systems, provide servicing to the systems, and build a commercial market in the same regions. 10 sustainable solar market packages are projected to directly benefit some 70,000 households. The programme is expected to cost between 15 and 20 million USD and targets 630,000 people living in 496 very small settlements not attached to bigger localities.
- Over 100,000 pico-systems sold by SolarAid/Sunny Money on a commercial basis with marketing costs facilitated by donors.





CONTRACTORS  
& MAINTENANCE

## Section 5: Institutional and Policy Frameworks



## Section 5: Institutional and policy frameworks

In order to achieve ambitious plans to electrify 50% of the population by 2020, the Tanzanian government has instituted a range of energy-sector reforms, which include the development of off-grid strategies and the attraction of private-sector investment to boost electricity supply (SREP 2013). Key energy policies and legislative frameworks are summarized in Table 5.

### 5.1 Policy & Legislative overview

| Legislation                                     | Year | Overview  | Approach to renewables   |
|---|------|---|--|
| <b>National Energy Policy</b>                   | 2003 | Revised in 2003 from the 1992 National Energy Policy. Focus is on market mechanisms and means to achieve an efficient energy sector balanced between national and commercial interests.   | Promotes RE sources and encourages private sector participation in RE sector. It also requires EWURA to pursue a light-handed approach to regulating SPP renewable energy projects.        |
| <b>New and Renewable Energy Policy</b>          | N/A  | A Terms of Reference has been drafted for a Consultant to write this document, but this has not yet been concluded.   | N/A  |
| <b>Energy and Water Utilities Authority Act</b> | 2001 | The act that forms EWURA, the regulator, and outlines powers and responsibilities for regulating a liberalised electricity sector.  | Liberalises electricity generation which enables both on- and off-grid renewable energy SPPs.  |
| <b>Rural Energy Act</b>                         | 2005 | Established the Rural Electrification Board, Agency and Fund and describes in considerable detail the functions and relationships of these different entities. It also provides more detail on sources of financing for the fund.   | By promoting electricity access in rural areas, the act has seen a number of RE projects, mainly solar and small hydro, being undertaken through REA and Ministry of Energy collaboration. |
| <b>Electricity Act</b>                          | 2008 | Was enacted to bring the competition of electricity sub-sector and increase efficient in power. It allows private power producers to generate electricity and sell it in bulky to the distribution companies or major consumers. It also demarcates the power electricity institutions in Tanzania. | Seen as not attractive to private sector in RE energy generation. Appears ambiguous and unstable, which is likely to worry PPPs.   |
| <b>Public Private Partnership Act</b>           | 2010 | Sets out regulations for preparation, assessment and contracting of all projects undertaken in partnership between the public and private sector.   | Provides legal background for IPPs to partner with the government institutions such a TANESCO in RE energy production  |

The above policies and legislation are being implemented through recently created institutions that, with the Ministry of Energy and Minerals (MEM), govern the energy sector. These agencies have mandates that specify their activities on off-grid access and renewables. The establishment of these agencies has been accompanied by reforms within TANESCO that allow other players to play a role in the electricity sector. Table 6 provides an overview of these energy access institutions.

**Table 6: Overview of main off-grid energy institutions**

| Institution  | Role   |
|--|--|
| <b>Ministry of Energy and Minerals (MEM)</b>                   | In charge of developing and reviewing Government policies in the energy supply industry. The Renewable Energy Division handles this sub-sector.  |
| <b>Energy and Water Utilities Regulatory Authority (EWURA)</b> | Multi-utilities regulation body in charge of the electricity, petroleum, gas and water sectors.  |
| <b>Rural Energy Agency (REA)</b>                               | Formed to promote rural socio-economic development by facilitating extended access to modern energy service in rural areas of Mainland Tanzania. Works as an institutional scheme with the Rural Energy Board (REB) and the Rural Electrification Fund (REF) |
| <b>Tanzania Electric Supply Company Limited (TANESCO)</b>      | Its core business is generation, transmission, distribution, and sale of electricity to the Tanzania Mainland and bulk power supply to the island of Zanzibar.   |

The development of strategic plans is also driving an off-grid and decentralized focus in the power sector. Relevant documents are listed in Table 7.

**Table 7: Overview of main off-grid energy institutions**

| Institution  | Year | Role   |
|--|------|--|
| <b>Power Sector Reform Strategy</b>                                | 2007 | The reform introduced the PPA module where TANESCO ceased from being the only power producer and enabled it to enter into PPA with PPPs to liberalize power supply to the grid. The reforms also covered regulation of rural and off-grid electrification and propelled the formation of a Rural Electrification Agency. |
| <b>Power System Master Plan 2007-2031</b>                          | 2007 | The master plan presents strategic visions, scenarios and action plans for enhancing Tanzania power Systems towards next generation smart power grid. It identifies short and medium term projects as well as the long term projects.  |
| <b>The Tanzania Rural Electrification Investment Prospectus</b>    | 2013 | Developed by REA in 2013 to delineate areas better suited to mini- and micro-grid and stand-alone electrification, thus allowing project development to focus on specific areas.   |
| <b>The Electricity (Development of Small Power Projects) Rules</b> | 2014 | An updated electricity generation rules for Small Power Producers (SSP) in Tanzania released by EWURA in 2014.   |



## 5.2 On-grid electrification policy & regulatory framework

The Electricity Act of 2008 opened up electricity generation to IPPs in a deliberate move to bring the private sector into energy generation, and limit TANESCO's monopoly. On and off-grid renewable projects can now sell power to TANESCO through Standardized Power Purchase Agreements (SPPA) (see below). The liberalization of electricity generation has had a major impact in opening up the electricity sector to more players, with 648MW of installed capacity (41% of the current total) coming from Public-Private Partnerships (PPPs).

Tanzania up to the mid-2000s was largely focused on grid-based electrification strategies for un-electrified rural areas. This was despite the fact that grid extension can reach only a maximum of about 50% of the population, and was losing TANESCO money with each new connection – as is common for utilities in the region – because of highly subsidised connection and unit costs to consumers (a unified tariff), and expensive distances to cover with transmission lines. Still, grid extensions were adding tens of thousands of new consumers to the grid each year – with the end-result that:

- TANESCO overstretched its limited budget to support rural electrification, and
- Many communities were left without any electricity because they were too far from the grid.

Dialogue between rural groups, the Government and development partners helped the country to realize there is a need for alternative approaches.



## 5.3 Off-grid electrification policy and regulatory framework

Compared to its East African peers, Tanzania has taken a lead in enacting policy and regulations to facilitate off-grid electrification. In an effort to decentralize Tanzania's power sector, improve electricity access, and foster domestic private sector investment in renewable power sources, MEM identified two decentralised approaches that can be executed by the private sector, cooperatives or community user groups. These two approaches, as mentioned above, are a) **mini-grids** and b) **stand-alone systems**.

### a) Mini-grids

Key to the new approaches was the development of a Small Power Producer (SPP<sup>1</sup>) program in mid-2009.<sup>2</sup> These regulations provide a legal basis for IPPs to develop mini-grids either by connecting into the TANESCO national grid, connecting to existing isolated mini-grids, or creating a new isolated mini-grid. SPP regulations were designed to stimulate private sector investment and have been successful; regulatory updates in 2014 have gone even further to remove obstacles and provide clarity for potential mini-grid developers.

The SPP regulations enable private and community groups to generate up to 10MW of renewable energy for sale under 3 possible models:

- An **isolated mini-grid** that generates power for retail sale directly to end users, and includes its own distribution grid;
- A **grid-tied mini-grid** that generates power for sale to and distribution by an existing TANESCO mini-grid. (*For the purposes of this report, we focus on these first two options*); and
- A **grid-tied mini-grid** that generates power for sale to and distribution by the national TANESCO grid.

EWURA has set up the following framework to encourage and guide off-grid renewable mini-grids in the country:

**Renewable sources of power.** Unless renewable sources are clearly cheaper than fossil fuels (and often even when they are), the government must send a signal to power producers that incentivises their use of RE. Tanzania has developed renewable energy Feed-in Tariffs (FiTs)<sup>3</sup> for SPPs feeding power into off-grid mini-grids; these are not technology-specific but rather

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1 Not to be confused with a Standardised Power Purchase Agreement (SPPA) or Standardised Power Purchase Tariff (SPPT), though both of these can apply to Small Power Producers (SPPs).

2 Tenenbaum, B. et al, *From the Bottom Up: How Small Power Producers and Mini-Grids Can Deliver Electrification and Renewable Energy in Africa*, 2014

3 The TANESCO feed-in tariff for IPPs connecting into existing off-grid mini-grids is TZS482.64/kWh (\$0.28/kWh) (2014). Connection to the main grid brings a much lower tariff. See EWURA, 2014.

based on the avoided cost of power production. They specifically mandate the use of renewables by SPPs – either renewable cogeneration (heat + power), 100% renewable energy, or a hybrid of renewables plus fossils (at a maximum of 25% fossil fuel) – and provide a higher tariff (than the on-grid FIT) to reflect this preference.

**Permits, registration and licensing.** The process for setting up an IPP and selling electricity can be onerous in many countries – lots of paperwork, approvals required, unclear or changing procedures, long delays and often corruption. Tanzania has taken proactive steps to simplify the process, though it still presents some difficulties.

Under the regulations, SPPs generating less than 1MW are exempt from licensing requirements, though they must still register with EWURA. SPPs selling power to businesses can also enter into sales contracts with these customers without regulatory approval terms of the contract, making it easier to establish retail relationships with higher-consumption off-takers.



**Sale of power to consumers (retail).** The issue of retail tariff setting for a mini-grid selling directly to end users is one of the biggest challenges for private sector IPPs, as the tariff that must be charged in order to reach commercial viability and investment attractiveness can be significantly higher than the subsidised TANESCO grid consumer rate. If the IPP were to charge a similar rate to TANESCO, in most cases it could not cover its own investment costs, let alone reach profitability.

In some countries (e.g. Kenya) a mini-grid developer is not authorised to charge a cost-reflective, commercially viable rate because it deviates from a nationally uniform (subsidised) tariff. This subsidised national tariff is designed according to the political and social ideal of providing equally priced electricity to all consumers, urban or rural. This is a major obstacle to growth of off-grid mini-grids in Kenya, although some micro-grid companies are charging higher retail tariffs without penalty from the regulator.

In Tanzania, it has not been legally required for IPPs to charge the subsidised TANESCO tariff, but charging anything more than this amount has been problematic because it clashes with political and social expectations about the “fair” (uniform) cost of power. Recognizing that this was a serious obstacle to the entry of private players into the off-grid power sector, in the 2014 SPP regulation revision EWURA went beyond merely allowing cost-reflective pricing and took an extraordinary and progressive step to actually require it. In doing so, they sent a message to IPPs: they are expected to be commercial sustainable.

It remains to be seen whether this shift by EWURA will pave the way for more mini-grid investment, or is merely a cosmetic change on what may be a more deeply rooted social understanding of “fair” pricing for electricity. Certainly in locations where the national grid is relatively close by, consumers may object to paying higher rates for off-grid power – a likelihood that offers a powerful argument for the importance of IPPs engaging with their target communities far in advance of building any infrastructure.

*In Tanzania, charging any more than the subsidised TANESCO tariff has been problematic because it clashes with political and social expectations about the “fair” cost of power*

IPPs must have their proposed tariffs reviewed by EWURA, with the exception of very small power producers (VSPPs) with an installed capacity of 100 kilowatts (kW) or less, for which EWURA does not need to approve of proposed retail tariffs. It retains the right, however, to review them if 15% of the customers complain.<sup>4</sup>

One option many mini-grid operators are experimenting with to sustain their business models is that of charging a different tariff to different categories of consumer (as many utilities do). For example, in an “ABC” model it may be that the large anchor consumer – possibly a local industry or government institution – pays a higher rate than a domestic consumer. This is an example of cross-subsidisation of ‘poorer’ consumers by ‘wealthier’, which is allowed in many national tariffs schemes (both between industrial-domestic and urban-rural) but has been discouraged up to now in off-grid Tanzanian systems. The new 2014 regulations explicitly legalise internal (to the mini-grid) cross-subsidisation.<sup>5</sup>

In considering the commercial viability of a private IPP it is important to consider (among other things) both the consumer usage tariff (as discussed above) and the consumer connection fee (see below).

**Sale of power to an off-taker (wholesale).** The other option for sale of renewable off-grid power is to a larger off-taker, which in Tanzania would be TANESCO, for distribution to its own consumers. As outlined above, an off-grid renewable power producer could feed either into the national grid or an existing TANESCO mini-grid (which is technically “off-grid” in the sense that it is not attached to the primary national generation, transmission and distribution infrastructure). In this report we focus on the latter – which means the distribution and retail sale of electricity is managed by TANESCO (at TANESCO consumer tariffs).

The SPP regulations enable sales of renewable electricity to be arranged through Standardised Power Purchase Agreements (SPPAs)<sup>6</sup>, which

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4 Tenenbaum, B. et al, Ibid.

5 It is not clear whether this would also apply, for example, to an IPP with multiple mini-grids who wanted to cross-subsidise from consumers on one grid to consumers on another, perhaps more remote grid.

6 The current Tanzanian SPPA template can be accessed online from EWURA [here](#). More general information on, and samples of, Standardised Power Purchase Agreements can be found [here](#). An initial discussion of the key features and PROs/CONs of a standardized contract can be found [here](#) (p10-15).

provide a 'template' alternative for smaller players to avoid a potentially costly process of negotiating power purchase tariffs and terms with TANESCO. The SPPA includes the following provisions:

- The off-taker must purchase the power supplied for 15 years.
- The off-taker is required to purchase power from the SPP, which protects the SPP against unexpected financial losses that might have occurred if the grid has sufficient power from other sources; it is not, on the other hand, required to pay for non-received power resulting from a malfunction or outage on the main grid ('take-or-pay'). The latter is a risk to the SPP. In the event, however, that the SPP cannot provide power for a short period of time – during repairs, for example – they need only to provide >24 hours' notice to the off-taker.
- A Feed-in Tariff calculated according to a Standardised Tariff Methodology, which is based not on technology (as many other countries' are) but on avoided costs. This means the rate is adjusted annually, and can be no lower than the original Year 0 rate and no higher than 50% more than this rate. This provides little long-term assurance needed by most SPPs; nor does the fact that tariffs are quoted in Tanzanian shillings (as opposed to US dollar), which creates foreign exchange risk for the SPP as well.



In theory an SPPA with the government utility would provide a stable revenue model for a private sector IPP. But in reality in Tanzania, TANESCO is severely crippled in its ability to purchase independently generated power, for the basic reason that it simply does not have the financial resources to do so. This is largely because:

- It is losing money on every subsidised consumer connection charge and tariff; and
- It is failing to collect payment on power provided to many of its customers, including (but not limited to) other government sectors.

The frequent effective insolvency of TANESCO thus generates a strong disincentive to potential investors and lenders.

**Connection to another isolated mini-grid or to the national grid.** An off-grid IPP will need clear guidelines for connecting to another grid in two possible project scenarios:

- At the start, if the intention is to feed power into the off-grid TANESCO mini-grid; or
- At some point in the future, if and when the TANESCO grid extends to the mini-grid's (formerly isolated) location.

The Tanzanian government has provided technical guidelines for connecting to the grid, but clear processes for compensation of or cooperation of a formerly off-grid private mini-grid owner (operating in a location that was formerly remote and has now been reached by the national grid) are not available. This will be an issue for grid-proximate mini-grid developers, but not very remote systems.

**Connection costs and consumer connection charges.** The provision of electricity to any consumer has costs associated with the initial physical connection of the household or business infrastructure to the distribution line. These costs are usually split between the distributor (either the national utility or an IPP) and the consumer. For clarity here, we call the distributor's side a "connection cost" (this usually represents the true cost of installing the hardware and setting the consumer up administratively) and the consumer's side a "connection charge" (which is usually a highly subsidised one-time fee that is meant both to defray a small portion of the connection cost, and also as a sort of 'entry barrier' to ensure only those with capacity to pay for power are given connections).

For both power distributors and consumers, the cost of connection is a significant portion of overall expenditures – and as such is often the highest barrier to rural electrification. In many cases a government off-grid mini-grid may be under-subscribed by consumers who simply cannot afford to get connected. This is another argument for early and on-going engagement of the IPP's target community, to understand likely levels of connection. It also points to the need for targeted support or subsidy to remove this type of specific barrier to development of off-grid renewable power systems. The REA, with support during TEDAP, has provided a \$500 subsidy per connection to off-grid projects, but this may not sufficiently address costs for either side.

**Taxes and subsidies.** The Tanzanian government has taken some steps to incentivise both renewables and off-grid power development through

financial mechanisms including taxes and subsidies. Much of this has been supported through the TEDAP programme:

- **Equipment.** Since 2005, solar and wind energy equipment and parts have been exempted from VAT and import duty as part of a clear effort to stimulate growth of this sector. A November 2014 VAT bill proposes to now re-instate this tax, which threatens the future of renewables in the country with an additional 18% on import costs, which are already high.

EWURA, on the other hand, has addressed a specific but important challenge regarding off-grid power equipment in its 2014 regulations. It now requires SPPs to take a depreciation on assets financed through grants – which removes a financial penalty on IPPs who needed soft funding to help them cover capital expenditures. This is part of a larger revision to the 2008 Electricity Law, which seemed to prohibit costs covered by ‘soft’ funding such as subsidies or grants from being reflected in the SPP’s operating costs. This revision goes hand-in-hand with the decision to enable cost-reflective tariff setting by the SPP.

- **Project development.** REA, through TEDAP support, has provided various financing for off-grid projects, including the \$500-per-connection grant noted above; a renewable energy project credit line with long term (15 year) financing – notable in a lending market that usually demands returns in half that amount of time; a loan refinancing facility; and in-kind or matching grants for technical assistance.

## **b) Stand-alone Systems**

The vast majority of renewably powered stand-alone systems are solar PV. As outlined above, the private sector market for solar pico, home systems and institutional systems is vibrant in Tanzania and requires much less in the way of regulatory governance and support than mini-grids – though arguably it needs more regulation than currently exists, in particular to address pricing and quality.

**Quality standards.** There are no national quality standards in place for equipment (at import) or installation (e.g. licensing for technicians). Tanzania as part of the East African Community is beholden to regional standards for solar PV products being imported into the country, but there is little more than cursory awareness or enforcement of these. The Tanzanian Bureau of Standards would develop and enforce any standards (in cooperation with key stakeholders such as private sector, NGOs, MEM, Customs and others), but they are still under development. To our knowledge EWURA is not planning any technical regulations (for installation quality), though recent introduction of solar regulations by the Kenyan regulator have not been entirely popular among some who would prefer a voluntary licensing scheme, and TAREA would be a natural option for support to develop a positive incentive based licensing mechanism.

**Taxation.** Equipment in these categories, with lower-income rural consumers as a primary market, is highly sensitive to price increases. To date, solar and wind energy parts have been VAT exempt; a bill is currently under consideration in Parliament to reinstate it – a move that would affect mini-grids as well.

**Subsidy.** Under TEDAP, a \$2.5/Watt subsidy was provided to private sector companies selling solar PV stand-alone systems, but this was not a broad success and the World Bank is unlikely to fund this going forward. It was designed so that retailers could reduce costs and pass along savings as price reductions to consumers, but this didn't happen – and the market was already in stiff price competition. Though this was one of many well-designed programmes that did succeed in some other markets, the general international consensus is now that a per unit subsidy is not as effective a tool as direct consumer micro-financing.





## Section 6: Recommended Policy Options for Off-Grid RE



*If the technology of cell phones could leapfrog the old landlines, then new electrification and energy technologies can do so too.*

## Section 6: Recommended Policy Options for Off-Grid Renewables

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A generation ago, many were optimistic that a rapid expansion of TANESCO's grid electric system could be achieved. However, like the old wire-based telephone networks, grid electricity has not spread fast enough and there is a need for a new paradigm.

Lessons can be learnt from the revolutionary development of cellular phone networks. Technology, business and ownership models are fundamentally different from the standard land-based phone system, and allow transformative changes. For off-grid electricity, this is also true --- solar PV, mini-hydro and even wind power can be funded and installed in ways that are completely different to the traditional grid electrification model. If the technology of cell phones could **leapfrog** the old landlines, then new electrification and energy technologies can do so too. It is notable that the transformation of the telecommunications market, guided as it was by technology, occurred because governments relaxed their controls of the sector and allowed private players to participate.

Below are recommendations of keys ways Parliament can work to improve off-grid renewable electricity in Tanzania.

### **Debating major issues of the day and pushing the public agenda**

“Pushing the public agenda”, the regular work of debating and engaging national discussion, needs to be carried out with energy issues. Energy and climate change are major issues that affect millions of Tanzanians in all parts of the country, and MPs have the ability to raise awareness of these topics through community engagement, public discussion, and parliamentary debate.

Parliamentary actions should include:

- Remind the Government and the public that the right to electricity is universal, even for those that are not near the TANESCO grid.
- Recognize the role of mini-grids and stand alone systems as part of a legitimate approach to rural electrification and ensure that these off-grid solutions are addressed in real ways, politically and financially.
- Strive to continuously improve rural electrification implementation plans, and to ensure that they are monitored effectively
- Push for more capacity building and vocational learning about renewable energy systems.
- Educate the public, major companies, government and each other
- Influence public discussion and direct it in a positive direction
- Represent and lobby for their constituents, particularly when their constituents have low access to energy or when they suffer from the problems caused by deforestation or energy poverty.

### **Legislative sanctions to create funds for energy access and renewably powered off-grid electrification**

The lack of off-grid electrification is rooted in a lack of sufficient established funding frameworks. Acts that establish institutions such as REA and EWURA must ensure their continuous funding, and Parliament must ensure that sources of funding evolve and improve with changing circumstances.



As mentioned above, the estimated cost of electrifying 30% of the country is \$3.5 billion over ten years. It has always been a struggle to ensure that these funds are available for the REA and TANESCO. Two major challenges faced by Tanzanian leaders are a) identifying revenue sources that will not negatively impacting other parts of the economy and b) ensuring that funds are allocated toward an effective 'package' of approaches, including grid-based electrification, off-grid electrification and modern cooking.

Parliamentary actions should include:

- Building on existing legislation which allocates funds for the REF/ REA
- Holding discussions on the creation of trust bodies or other 'ring-fenced' budgets for rural energy funding

- Identifying and encouraging finance from the private sector and providing incentives to channel it into rural energy.

### **Exercising parliamentary oversight and approving/amending government budgets**

In many Sub-Saharan African countries, Parliaments have a limited oversight role in budget development and approval processes because a) funding is often tied to projects in a way that leaves less room for debate and b) because of its limited session period, Parliament has limited input into the formation and definition of national budgets.

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However, despite these limits, MPs still have a vital oversight role to play. Parliamentarian actions should include:

- As much as possible, ensuring that adequate budgets are available for rural electrification
- Ensure that budgets are split strategically between grid extension and off-grid approaches
- Monitor plans and targets of government institutions annually to ensure that they are both realistic and ambitious
- Monitor performance of government institutions and agencies against targets
- Ensuring that these funds are properly channelled and utilized against transparent indicators

### **Creating the policy and legislative environment**

Tanzania already has in place many of the key framework structures to stimulate investment in off-grid renewables. Major recommendations for Parliamentarians are as follows:

#### **Commit to renewable energy at a high level.**

The re-direction of the national energy sector requires both strong government leadership and support by Parliamentarians acting on behalf of their constituents. It requires widespread awareness of the economic, social and environmental benefits of shifting to renewables – and a steady movement towards decisive action.

It is not easy to shift the national energy sector toward clean and renewable energy. Certain actors may prefer the system remain as it is for their own gain. Others may see short-term economics as trumping long-term. Still others may just not understand what renewable energy resources offer,

and may not consider them a ‘serious’ solution.

As such, Tanzania has acknowledged the role that renewables can play, while still remaining primarily focused on petroleum fuels and hydropower. There is currently no Renewable Energy Policy or Renewable Energy Strategy to guide the legislative and budgetary processes toward clean energy. What frameworks and incentives for renewables are in place must battle with simultaneous support for fossil fuels. Parliaments should work to:

- Finalise an ambitious but realistic national Renewable Energy Policy and Renewable Energy Strategy that set clear targets, a clear path for achieving them and instruct Treasury to allocate funds accordingly.
- Regulate and tax fossil fuels (including natural gas) in accordance with a clear, consistent national policy to shift away from these energy sources. This would both dis-incentivise long-term reliance on these resources and create a funding stream for renewables.

#### **Commit to off-grid solutions as part of a rural electrification strategy.**



Tanzania’s national policy acknowledges the limits of grid extension as a mechanism for reaching the rural population – but this is not manifested in annual budgets. Nearly 90% of government expenditures on electrification go to grid extension – and when there is a budget shortfall, this means nothing is left for off-grid options. Off-grid renewable solutions for millions of rural households, businesses and industries will not happen without the government budgeting for it. Parliamentarians should work to:

- Allocate and ring-fence funds (20-40% of rural electrification expenditures) to off-grid solutions. These can fund various facets of off-grid electrification, including new connection subsidies (REA), Feed-in Tariffs (TANESCO), capital expenditures for mini-grids, consumer financing programmes, feasibility work (although this was not as successful for TEDAP) or a range of other options. This sends a strong message to investors of government intent and support.
- Minimise political and last-minute uses for rural electrification funds. Adding new power connections in a particular region or constituency is a powerful political tool – especially in the lead-up to elections. This may benefit some in the short term – but can derail national plans, and severely compromise Tanzania’s ability to attract investors.

- Recognise the importance of productive off-grid power. Providing a physical connection to a TANESCO grid may not be appropriate for consumers with low capacity to pay and low demand for power. Innovative off-grid businesses may package power alongside appliances for using it, or may sell power in its “value-added” form (i.e. not per kWh but per service or function) – functions that create demand and improve livelihoods, but that are beyond the remit of TANESCO. Investors must be assured that these mechanisms will have the support of government – and not be overregulated, taxed or otherwise hindered.

**Ensure TANESCO and the REA have the funding and structure to implement their mandate.**

Though TANESCO collects revenue from electricity consumers, it operates at a loss, and its available funds are often at the mercy of other government actors. This creates uncertainty for investors looking to apply for Feed-in Tariffs, and neither investors nor the lending institutions they seek financing from will enter such a high-risk situation. The REA’s funding, from Treasury and donors primarily, must be safeguarded as outlined above under the other tasks of Parliament.

In addition to its financing, the institutional structure of the REA – centralised, and tasked with major activities on a relatively slim staffing – may not be the most efficient. Procurement of renewable off-grid systems for government programmes, for example, can take years.

*Nearly 90% of government expenditures on electrification go to grid extension – and when there is a budget shortfall, this means nothing is left for off-grid options.*

Dispensing subsidies or taking decisions on specific projects can be time-consuming and cumbersome for an investor, especially a smaller or community-based entity looking to set up a mini-grid or stand-alone programme. Parliamentarians should work to:

- Assist TANESCO in improving and ensuring its sound financial standing. This may include a range of advocacy and oversight activities, including protecting existing funds from misallocation; helping them to enforce bill payment and revenue collection; monitoring long-term Power Purchase Agreements; advocating for tariff structures that make both political and economic sense from a conceptual standpoint – such as cross-subsidisation or promotion of renewables (where fuel is free); and building awareness and capacity within the institution to deliver services as efficiently as possible.
- Consider options for partial decentralisation of REA, so as to enable direct action on regional off-grid projects. Some central management of the national rural electrification programme is

essential. But selective decentralising of certain administrative, funding, monitoring, procurement, system design and decision-making processes to regional offices could improve the efficiency with which implementation occurs as well as the general perceptions of increased access to government by project developers. It would also reduce the possibility (or perception thereof) of unequal allocation of resources to certain regions over others. Of course, any decentralisation would need to be balanced to avoid merely bulking up the agency with additional staff and adding unnecessary new procedures. The objective would be to simplify, increase efficiency and transparency, and stimulate projects relevant to each region.

### **Support options for project developers and consumers to access financing and credit from local and international sources.**

This may be coordinated with donor partners or locally active NGOs; it may be specific to one's constituency or region; it may involve creation of a new programme targeting a specific gap in the mini-grid project cycle – e.g. loan guarantees, educating local banks on issues specific to project-based lending as opposed to asset-based lending, connecting/matchmaking investors and financiers, addressing minimum equity constraints for VSPPs, facilitating consumer microfinance schemes, or other; or the stand-alone system value chain – e.g. consumer microfinance or microcredit support.

### **Work at the regional level within EAC and SADC Parliaments (and other groups) to promote renewables.**

This includes engaging fellow Parliamentarians on successes and challenges in their countries and constituencies, for learning and networking of renewable energy interests. It may also involve addressing issues to do with positive import and taxation schemes, movement of skilled labour, harmonisation of standards, and other issues that have potential to benefit Tanzanian off-grid renewables markets.

### **Balance negative with positive incentives.**

Advocacy and legislation to promote off-grid renewables must recognise human (and investor) nature: people should be steered toward developing markets as envisioned in the national policy using both 'carrots' and 'sticks'.

'Carrots' – positive incentives – should smooth the way for an investor; offer a reduction in cost or time; enable a profit to be made; or make things easier and investment more likely to scale up. They send a clear

message to investors that the government is committed to action in a particular sector, and sees private sector involvement as desirable and worthy of support. Positive incentives include subsidies, tax breaks, licensing waivers, one-stop-shops, and other encouragements.

‘Sticks’ – or dis-incentives – should send a clear message about penalties for non-compliance and choices the government does not want an investor to take. These may include taxes, detailed rules and regulations, licensing and reporting requirements, administrative paperwork, risks allocated to an investor, and other discouragements. Parliamentarians will not have sway over all incentives, but may work in particular to:

- Ensure that Renewable Energy technologies – and any other technologies associated with mini-grids – are exempted from VAT. This is currently under debate in Parliament and those with an interest in promoting this sector should strongly urge their colleagues to exempt RE and off-grid technologies from VAT.
- Encourage positive incentives for the use of renewables, to complement any currently in place. This may include offering a ‘reward’ for high performance rather than merely a penalty for low performance (the latter of which is notoriously difficult to monitor); performance-based tax exemptions or subsidies for ‘green’ IPPs; in-kind support to private project developers and investors who achieve certain milestones, innovate productive services for their customers, aggregate projects for ease of scaling; or various other options. Any incentive system must recognise need for longevity and predictability – two issues of paramount importance to an investor.
- Support the establishment of national solar PV quality equipment standards, based on regional (EAC) and international best practice. This would require consultations between either the Tanzanian Bureau of Standards (for compliance-based standards) or the Tanzania Renewable Energy Association (TAREA – for voluntary accreditation) and relevant stakeholders, including the customs unit charged with inspecting imports. In doing this, recognise that enforcement is not easy – logistically and financially – and a voluntary scheme based around training, awareness and positive incentives for compliance would be preferable.

The above recommendations offer an overview of actions Parliamentarians can take to stimulate investment in off-grid renewables in Tanzania. Intelligent leadership, combined with strong actors, can make a huge difference. Parliamentarians have a strong role to play in setting the agenda and in inspiring the country to change positively. The basic framework is already there, and a model for other countries. More than anything, what is needed is the political will to make Tanzania green and electrified – and the rest will come.



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## Annex 1: Case Studies

The first two Tanzanian case studies below illustrate how development of mini-grid solutions can enable communities and industry to rapidly access electricity before TANESCO reaches the area. They are followed by relevant examples from other countries on off-grid and renewables more generally.

### **Mwenge Hydro Generation and Rural Electrification Project**

Mwenge project is a 4 MW hydro power plant located at Mufindi District in the Tanzanian Highlands. The USD 10M project commissioned in 2012 was financed by the ACP-EU Energy Facility and the Tanzania's Rural Energy Agency (REA) and implemented by Rift Valley Corporation.

The produced electricity is supplied to the TANESCO grid, the local tea industry and a rural community with approximately 25 GW/h of green power per annum<sup>1</sup>. An extensive rural electrification program is part of the project, bringing green, sustainable electricity to 14 villages that contain over 3,000 rural households and a population of approximately 25,000 people in the project region. This includes the construction of 120 km of power lines and the operation of an innovative cellular phone based, pre-paid electricity vending-system to sell electricity directly to customers.

The fully privately owned project is the first Greenfield project in Tanzania under the relatively new SPPA scheme showing how the policy change is starting to attract investors. All rural customers are supplied at the existing TANESCO tariffs, including the subsidized D1 tariff for rural domestic connections, which make up more than 80% of connections. The use of innovative and unique cellular phone based prepaid metering system has enable economical sell of small quantities of power to large numbers of remote rural customers. The project has changed the social economic status of many people in the covered areas with new businesses opening up and education standards in the connected schools improving.

### **Njombe Off-grid Biomass Mini-grid (TANWAT)**

With the change in the Tanzanian national regulatory framework in 1994 to allow private electricity generation projects like the Njombe Off-grid Biomass Mini-grid have been able to take off. The standardized PPA contracts and standard tariff methodology introduced in 2008 enabled TANWAT to better plan its business and to make profitable use of excess biomass from waste wood.

Tanganyika Wattle Company as a private owner operator sells surplus

electricity through a PPA to a TANESCO nationally-run off-grid mini-grid. Founded in 1994 and located on 15,000 hectares of private forest in the southern highlands of Tanzania, TANWAT was established to meet high demand for tannin extracted from the wattle tree for use in the leather industry, and also produce timber for the local markets. The availability of excess wood waste led the company to set up an electricity co-generation plant in 1995, becoming Tanzania's first commercial wood-fired power plant with an installed capacity of 2.5 MW. The plant at first was off-grid and power produced only was meant to meet the need of TANWAT. Later it was connected to a regional mini-grid and, ultimately, the national grid. Currently, it sells excess power generated to TANESCO.

The plant uses biomass technology to generate electricity. The biomass includes waste products from wattle extracts, eucalyptus and pine trees obtained from the sawmill within the forest estate to generate power through cogeneration for its own processing facility as well as to the Njombe TANESCO mini-grid. The site has fuel handling and processing facilities that include a hydraulic feeder or logger, a drum chipper with a capacity of 70m<sup>3</sup> loose chips per hour, a chip belt conveyer and two silos, each capable of storing 17 tons of chips.

The TANWAT plant utilizes a private operator model. As per the SPPA, TANWAT owns the plant and ensures reliable power production while TANESCO is responsible for distribution and maintaining the quality of power to consumers. It has enabled TANESCO to reduce use of the diesel plants that had previously been serving this mini-grid, resulting in cost savings on electricity provision.

The Njobe off-grid biomass mini-grid case study shows that public-private models for off-grid power generation can work in Tanzania. It also brings forth the need for the government to standardize the PPA contract and tariff methodology to reduce the time and investment costs for private investors in implementing power projects, and the need for a special tariff for renewables feeding into a national grid (or mini-grid) to encourage use of RE which can offer a more cost-effective option for rural electrification as compared with diesel power plants.

The regulatory framework in Senegal promotes the electrification of remote areas where grid concessionaires and ASER (the rural electrification agency) do not provide electricity; this is done through Local Rural Electrification Initiatives (ERIL) for which international financial support is available. Government remains the owner of the assets, and a private firm or community group obtains a concession for operations and maintenance. 80% of the up front investment cost is financed by a donor (GIZ), 10% by customers, and 10% by the private operator. A rural electrification fund has been established to support the ERILs, though it has had limited use to date; going forward it seeks to become self-financing through a 0.7% levy on all electricity sold nationwide. This levy has been passed in law but is not yet implemented. A tariff system is in place that offers predictable long-term returns, giving private sector operators a potential for up to 15-25% over a project life of 15 years. One third of all revenues

are earmarked for deposit in an escrow account to cover the amortisation of equipment. This deposit scheme has been successful, with operators depositing funds when payments are collected, and the account controls preventing misappropriation of funds. To date, 18 'green' and hybrid mini-grids have been implemented.

In order to improve rural electricity supply, the Government of Rwanda encouraged private firms to design, finance and construct their own micro-hydro plants through a Public Private Partnership (PPP) program and a range of other incentives including a 'one-stop shop' for investors, targeted subsidies and tax exemptions. Initially the plants were designed to include a mini-grid to distribute the power to surrounding villages, but in the end all plants were connected to the national grid directly, which significantly changed the business model. This offers a good example of how strong government leadership can directly stimulate development of IPPs, and also of the need for clear coordination between grid extension planning and any off-grid programmes.

Kenya, Tanzania and Uganda are large private sector markets for stand-alone power systems, and are considered success stories for pico-solar and solar home systems. The CEO of Tanzanian solar company Helvetica Solar was named to a recent CNN Top 10 Entrepreneurs in Africa list. Challenges primarily focus on quality of parts and installations; but although blame for this is often laid on lax customs officials or poorly trained jua-kali (informal sector) technicians, this isn't entirely fair. As the markets have evolved, the strong competition has resulted in a pricing war, and consumers have generally chosen price over quality as their guide. This can be addressed by some improvements to monitoring the supply chain; but overregulation can also negatively affect the market (for example, Kenyan efforts at regulating technicians in 2014 have led to some backlash, seen as a difficult hurdle with no positive incentive attached). A highly successful market in Bangladesh developed on the heels of a national solar PV program, supported by government and the World Bank at high levels, which provided voluntary technical standards by which other incentives could be accessed, such as consumer financing through cooperatives and other rural financing players.

Germany offers an example of a Parliament that led a renewable energy transformation. During the late 1990s in Germany, a small group of "Green" parliamentarians helped shift the balance of a coalition government and, in return for providing their votes, they were given control of the Ministry of Energy. During the time they managed the energy portfolio, the green parliamentarians instituted a new energy program that replaced coal and nuclear energy with renewables such as solar, wind and biogas. From their seats in Parliament, they put in place a fiscal environment that stimulated Germany's renewable energy industry and enabled it to flourish. Now, almost 20 years later, on many summer afternoons over 50% of the country's electric production comes from solar and wind. Not only did German parliamentarians transform their own country's energy picture, they also revolutionized solar energy globally and are leaders of the world's green energy transformation.

## Annex 2: Glossary

**Solar Photovoltaic (PV) system:** An installation of several components including solar panels and inverters to absorb and directly convert solar energy to electricity.

**Solar Pico PV System:** A small PV-system with a power output of 1 to 10W, mainly used for lighting and mobile charging.

**Stand-alone system:** Stand-alone systems are electricity generation systems installed directly at an end-user's premises without any distribution network. Electricity is commonly generated from solar PV but it can also come from other sources such as wind, small hydro, diesel generator or biofuel.

**Solar Home System:** A solar PV system usually between 10-200W installed for lighting and powering small home electrical appliances. The system also needs a rechargeable battery, so that power is available at night and on cloudy days.

**Mini-grid:** A self-contained electricity generation and distribution system where the produced electricity is fed into a distribution network that provides a number of end-users with electricity in their premises

**Micro-grid:** Similar to mini-grids, but operate at a smaller size and capacity

**Hydro power:** Electricity generated through rotation of turbine using shaft power from falling water.

**Small hydro:** Hydro power plants with a capacity of up to 10 MW per plant.

**Energy Poverty:** Lack of access to modern energy services.

**Energy Access:** Access to both electricity and the services it provides for household domestic use and access to clean cooking and heating systems. It includes access to productive energy such as mechanical power which supports value adding activities and/or income generation.