



Mini-Grid Policy Toolkit – Case Study



Country: TANZANIA

Project: Njombe Off-grid Biomass Mini-grid

Private Operator Model

Project Summary



The Tanganyika Wattle Company (TANWAT) biomass co-generation plant
(Source: Tatedo Tanzania)

The Tanzanian national regulatory framework was changed in 1994 to allow private electricity generation as it became clear that the Government would not be able to supply electricity to many rural areas. After 2008, standardized Power Purchase Agreements (PPAs) and a standard tariff methodology led to the first private investments in electricity generation in remote areas, which also resulted in additional customer connections. The business model includes a private owner-operator who generates electricity and uses part of it for the company's electricity supply or distributes it and sells it to its electricity customers, and surplus electricity is sold to TANESCO, the national utility, through a PPA. Clear rules and incentives were crucial for the private sector to start gaining electricity supply.

This case study examines a private owner-operator, Tanganyika Wattle Company (TANWAT), who sells surplus electricity through a PPA to a nationally-run off-grid mini-grid as an example for an early private sector investment under the constantly evolving and improving regulatory framework.

Background

TANWAT was founded in 1949 and is a fully owned subsidiary of the Commonwealth Development Corporation (CDC). It was established to meet high demand for tannin extracted from the wattle tree for use in the leather industry and also produces timber for local markets. It is located on 15,000 hectares of private forest in the southern highlands of Tanzania. A decline in the market for leather goods starting in the 1960s due to competition from synthetic materials resulted in TANWAT taking measures to diversify from its reliance on tannin production, leading TANWAT to incorporate timber production on its land. The availability of excess wood waste led the company to setup an electricity



co-generation plant in 1995, and TANWAT became Tanzania's first commercial wood-fired power plant with an installed capacity of 2.5 MW. Initially, the plant was off-grid and the power produced was only meant to meet the need of TANWAT, but later it was connected to a regional mini-grid and, ultimately, the national grid. Currently, it sells excess power generated to TANESCO.

Basic Information

Location	Njombe, southern Tanzania
Project implementer	Tanzania Wattle Company (TANWAT)
Project date	1995
Beneficiaries	Private company; surrounding community
Project cost	GBP 2.6 million
Organisations involved	Industrial cogeneration for personal use, selling surplus power to a nationally-owned mini-grid run by TANESCO

Policy & Regulatory Framework

Tanzania is a vast country with a large rural population. The rate of access to electricity services (electrified settlements) in Tanzania remains very low today – less than 12%, and it will still be many years until the interconnected grid will reach the entirety of the isolated population. TANESCO uses off-grid diesel power plants to meet rural electrification objectives, given that grid extension to sparsely populated areas is technically and financially unattractive. Operating diesel power plants in remote locations is also very expensive, though, and TANESCO has pursued a strategy of gradually reducing their reliance on diesel power through the use of alternative power generation.

In 1994 the government dismantled TANESCO's generation, transmission, and distribution monopoly and began allowing Independent Power Producers (IPPs) to generate electricity for sale into the grid. The Energy and Water Utilities Regulatory Authority (EWURA) handles policy-making and regulation of the electricity industry, and in 2005 the Rural Energy Agency (REA) and Rural Energy Fund (REF) were established to promote rural electrification.

There is no special feed-in tariff (FIT) in place for renewable energy. Instead, in 2009, the Government incentivized independent power production through the establishment of a standardized mechanism for developing small power projects (SPPs) using Standardized Power Purchase Agreements (SPPA) for main grid and off-grid, and a Standardized Tariff Methodology (STM) for main grid. With added security of a government buyer and clear, formalized power purchase mechanisms, more private sector players began venturing into power generation.

Following its mandate to attract private investors for rural electrification, EWURA designed the SPP2 rules, which are now available in their second generation version. These rules provide a clear structure for grid connected SPPs as well as for isolated mini-grids with their own electricity generation and distribution. Projects below 1 MW do not require a license but just need to register



with the regulator, while projects below 100 kW are not only exempt from licensing but also from tariff approval. The rules cover small power producers that supply customers in the mini-grid and feed surplus electricity to TANESCO, small power distributors that buy electricity in bulk from TANESCO and re-distribute to their customers, and cases where the generator and distributor are one entity. Tariffs are calculated using a cost-plus method and theoretically, all magnitudes of tariffs are acceptable as long as costs are reasonable.

The current version of the SPP2 rules does not provide full protection from stranded investment in the event of main-grid connection for isolated privately operated mini-grids with generation and distribution activities, but it foresees three different scenarios in the event of main-grid connection:

1. The mini-grid operator sells its distribution grid to TANESCO and dismantles its generation assets.
2. The mini-grid operator buys electricity from TANESCO and distributes and sells it to its electricity customers.
3. The mini-grid operator generates electricity, sells it to its customers, and feed excess electricity to TANESCO.

Technology

Overview

The TANWAT plant uses biomass technology, which includes waste products from wattle extracts, eucalyptus, and pine trees obtained from a sawmill within the forest estate, to provide power for its own processing facility as well as to the Njombe TANESCO mini-grid. The plant has a forest estate of about 8000 hectares of wattle, 4000 hectares of pine and 1000 hectares of eucalyptus from which it obtains its feedstock (fuel).



Feedstock at the TANWAT plant
(Source: Tatedo Tanzania)



Technology Approach

The site has fuel handling and processing facilities that include a hydraulic feeder or logger, a drum chipper with a capacity of 70m³ loose chips per hour, a chip belt conveyer, and two silos, each capable of storing 17 tons of chips.

TANWAT runs two water tube boilers, each with a rated wood consumption of 60-80 tons per day, and a rated output of 15 tons per hour at 330°C and 30 bars pressure. The superheated steam from the boiler runs a condensing terry steam turbine at a speed of 5345 RPM that is connected to generators with a rated output of 3,125 kVA at 3.3 kV. The generators operate at a frequency of 50 hertz.

The total installed capacity is 2.5 MW. There is no battery storage; surplus energy is fed into the grid. The medium level distribution voltage used in the Njombe mini-grid is 33kV; the low level voltage is 0.433 kV for three phase and 0.240 kV for single phase. Pre-paid meters are used for monitoring electricity consumption and enabling customer payments.

Operator Model

Ownership and operations

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. This project started as a fully private model and became a “hybrid” model. When it was connected to the national grid, TANESCO took over all aspects of the mini-grid and provided an SPPA arrangement for TANWAT based on power sales.

Once the TANWAT plant was operational, TANESCO was able to reduce use of the diesel plants that had previously been serving this mini-grid, resulting in cost savings on electricity provision. Depending on the capacity factor and thus the efficiency of operation, the TANWAT plant operates at 0.09-0.12 USD per kWh. Electricity is sold to customers at national grid tariff rates.

Lessons Learned

- ✓ The example of the Njombe mini-grid, and others like it in Tanzania, show that public-private models for off-grid power generation can work.
- ✓ To encourage private contributions to off-grid mini-grids, governments should offer a standardized PPA contract and STM, which can significantly reduce the time and investment costs for a private investor to implement a power project.
- ✓ Renewables can offer a more cost-effective option for rural electrification as compared with diesel power plants. Utilities currently dealing with high operating and maintenance costs for diesel plants would benefit from close examination of incorporating (or entirely switching to) renewable power generation.
- ✓ Currently there is no special tariff for renewables feeding into a national grid (or mini-grid). A



FiT designed to incentivize specific (renewable) technologies would help to stimulate private sector investment in renewable projects.

- ✓ TANWAT is a good example of a project that grew “organically” with the existing regulatory framework. Its power generation was initially established to provide power for loads within the plantation site. The system evolved to provide power to the local mini-grid (with negotiated purchase agreements). Finally, when the region was connected to the national grid, it received a standardized PPA.