Mini-Grid Policy Toolkit- Case Study

Country: RWANDA

Project: Private sector mini-grid development

Private Operator Model

Project Summary

Maintenance technicians inside the powerhouse of one of the hydro plants constructed (Source : Robert Van der Plas)

The regulatory framework in Rwanda permits and favours private sector involvement, and programmes are in place to facilitate public-private as well as private ownership of electricity generation plants. One of these programmes, PSP hydro - a multi-donor programme run by Energising Development (EnDev) supporting private sector participation in micro-hydro power development, assisted private companies in arranging commercial financing for micro-hydro plants with mini-grids for power distribution. However, the national grid extension was so fast in this small country that by the time these micro-hydro plants were about to become operational, the availability of grid connection rendered mini-grids unnecessary.

Background

In order to improve the sustainability of rural electricity supply, the Government of Rwanda encouraged local private firms to design, finance, and construct their own micro-hydro plants through a Public Private Partnership (PPP) programme. Initially the plants were designed to include a mini-grid to distribute power to surrounding villages, but in the end all plants were connected to the national grid without mini-grids.

There are two reasons for this:

(i) The national grid expanded much faster than foreseen at the start of the activity, putting the plants within grid connection distance (the utility has an obligation to connect both new clients and private power plants within 10 km of the grid); and
(ii) To alleviate risks and increase the financial viability, banks started to require that project developers have a signed Power Purchase Agreement (PPA) with the national utility (currently this is the Rwandan Energy Group (REG), which combines the Energy Development Corporation (EDCL) and the Energy Utility Corporation (EUCL) under one roof) so they are able to sell all of the produced

electricity.

At the time of the design of the PSP hydro programme the Government was focused on public sector delivery. The Government had set ambitious targets, and their vision was that this should be done through public tendering. The private sector approach was deemed viable for large-scale projects, such as the 100 MW Kivu methane plant, but not for smaller (micro-hydro, village grids) types.

At that time, the electricity law existed in draft form and the national utility at the time, ELECTROGAZ, still had the de facto monopoly over the entire electricity sector. Nevertheless, MININFRA and Rwanda Utilities Regulatory Authority (RURA) agreed that, as a pilot project, the private approach would be interesting, although the expectations were low. However, private sector response was good, and several project proposals went forward to construct micro-hydro plants coupled with mini-grids.

In the course of the development it became clear that a number of regulatory issues would need to be addressed. The *Environmental Impact Assessment* procedure was developed and put in place along with the procedure for licensing an Independent Power Producer(IPP) and the mechanism to agree on a PPA. Numerous discussions were held with RURA, MININFRA, and Energy, Water and Sanitation Authority (EWSA) to review how to better assist the private investors along the process of operationalising their plants.

Although progress by the private sector actors was not as quick as initially anticipated, the plants developed through public tenders took equal or longer to realise (with one or two exceptions). This private sector approach has resulted in a reliable supply of electricity, particularly compared to village-operated plants. The Government of Rwanda actively engaged the PSP hydro project in the development of a regulatory framework to allow private sector inputs. This framework is now fully accepted and has become the norm. A procedure to further formalize this approach into an investment process is currently undergoing preparation.

Policy & Regulatory Framework

Overview

The Electricity Law was approved by the Parliament in 2011. The regulatory body RURA issues licenses to power producers, distributers, and transmitters.

In principle, private companies can undertake all of the above, but in practice power transmission and distribution remain the sole responsibility of REG. However, this may change in the future. The Rwanda Development Board (RDB) acts as a gateway for international investors interested in the Rwandan energy sector. MININFRA offers a MoU to the project developer to explore a specific site and develop a feasibility study. After an agreement with REG on the PPA, a concession agreement is signed between MININFRA and the project developer. The regulatory agency RURA thereafter grants a generation license.

Grid Extension

The multi-donor funded Electricity Access Roll-out Programme is responsible for grid extension and is implemented by REG. Grid extension plans are usually available for the next two years, but may also change according to political priorities and budget availability. In its initial phase, the national electricity network progressed much faster than foreseen. The utility was given instructions to connect individual customers within a 5 km radius as well as private power producers within a 10 km range of the then-existing medium voltage transmission network. As such, all PPP supported plants that were designed to be off-grid were, by the time they were ready to supply power, within a few kilometres from the national grid and therefore, simply connected to it. Due to cost-effectiveness considerations and limited funds, the political target of grid extension has been revised from 70% to 48% to be achieved by 2017/18.

Rural Electrification

The Government's target is to provide electricity access to 22% of the population until 2017/18. MININFRA is developing an off-grid strategy, and RURA will approve a simplified licensing framework for rural electrification in the summer of 2015.

Grid Feed-in Tariffs (FiTs)

Since 2012, a renewable energy feed-in tariff (REFIT) regulation for hydropower has been in place that offers a size-dependent tariff and is stipulated to connect all IPPs within a 10 km distance to the grid at the cost of the utility. The tariff is inflation adjusted, and to attract foreign investors, the REFIT is valued in USD, although it can be paid in RW francs. However, the REFIT expired in March 2015 and has not been renewed thus far. The utility is currently reluctant to connect power plants below 1 MW, and in such cases, requires the IPP to bear the cost of the grid connection.

Subsidies

Several subsidy schemes are in place. Since 2006, EnDev has supported private sector participation in micro-hydro power development through financial and technical assistance. In this programme, private project developers are invited to participate in a tender set up by REG and EnDev. EnDev supports the companies with business plan development and provides viability gap funding. There are currently three plants in operation (Murunda 95kW, Musarara 430 kW, and Mazimeru 500 kW), and two more are at an advanced stage of development. In the ongoing phase, six new plants are expected to be implemented with the support of the GIZ-managed EnDev programme. The Global Village Energy Partnership (GVEP) has a similar programme, financed by the World Bank, in place. The Government of Rwanda has recently approved the leasing of 15 publicly owned micro-hydro plants, and will progressively use the PPP approach for developing new micro-hydro plants.

Taxation

For new companies and companies investing in rural areas, there are quite a few temporary tax exemptions. The RDB operates a one-stop centre offering foreign investors assistance with these processes. For most renewable energy equipment, duty exemptions exist and the process with RDB is transparent.

Technology

Technology Approach

Intake dam at one of the Rwandan mini-grid sites
Source: www.reprorwanda.com

The technology used is a run-of-river micro-hydropower scheme, in which water turbines are used to generate power from water flow. Under this scheme, there is no water storage. However, there are small basins with water that act as storage which provide limited protection in the event of low water supply.

The hydropower generation is done using action turbines, which are suitable and have relatively high efficiencies for the range of 50-500 kW capacity and for the range of heads found in Rwanda. The three existing private plants all have European manufactured turbines. The turbine manufacturers come with necessary services including assistance in plant design, equipment installation, commissioning, and after sales services.

The control units are installed and calibrated by the turbine supplier as one integrated package. National grid technical standards apply, as it was always planned to connect the plant and mini-grid to the national grid at some point.

The turbine and controls ranged from USD 860 to 1300 per kW. LV and MV lines cost around USD 50,000 and USD 62,000 per km, respectively, to construct. Electricity produced costs between 0.08 and 0.12 USD/kWh, dependent mainly on the capacity of the plant. The payback time negotiated by the private project developers ranges from 5 to 10 years.

The capacity factor depends on the water flow, national grid availability, and technical issues. In practice, a capacity factor of 60-65% is realistic. The largest aspect influencing this is the water flow; one of the plants shows that the national grid was not available for 9% of the time. The dry season lasts about 3-4 months, during which this particular plant underperforms, while during the rest of the

year it performs more in line with the design parameters. There is an optimization study to be done, with trade-offs between investment costs (capacity of the plant) and capacity factor.

Operator Model

Ownership and operations

The operator models examined here are those of privately owned plants (regulated), which ideally offer greater efficiency and reliability than community run plants. The project developers were required to register a limited liability company, present a business plan, and handle all licensing, regulatory approvals, financing, construction, etc. All three companies that now have an operational plant are working on a second hydro plant, for which they need much less assistance.

The transmission system is normally built by the national power company. However, in the past, private firms were allowed to construct a system and were provided a reimbursement when they needed the line earlier than EWSA could avail it. In such cases, the national power company remains the owner of the transmission line. In the recent past, REG requires IPPs to build and transfer the required grid connection at their own cost.

The distribution grid is constructed by the national power company. It was initially agreed that the micro utilities would construct their own distribution network, but this idea was dropped when it became clear that the plants could be grid-connected.

At the time of project design, in 2005/2006, the grid was not far advanced and all plants were more than 15 km from the grid. Starting in 2010, the Electricity Access Roll out Programme (EARP) undertook the task of connecting all district towns to complete the national backbone. In principle, roughly 75% of the population should now be within a radius of 5 km from the network.

This had consequences for the private project developers, as they could now easily connect to the national grid – within 10 km EWSA had the obligation to connect any IPP and buy 100% of the power they produce at the prevailing REFIT tariff. There was no framework to allow project developers to operate as power generators and distributors at the same time. The PPA restricted the project developers to only operate and sell power to the utility, and thus mini-grids were no longer an option. However, this might change in the near future with the new off-grid regulation that also foresees a small power distribution license model. Still, for financial viability reasons, a grid connection is much more attractive than operating a mini-grid with much lower utilization rates. The banks realised this, and as they gained more experience with micro-hydro plants, they started asking for PPA contracts from the beginning and were reluctant to provide financing without a grid connection to evacuate the power.

The owner of the plant is fully responsible for the operation and maintenance (O&M) as well as any emergency repairs.

The financing model proposed was a combination of up to 50% investment subsidy grant, with owner

equity of 15-20%, and commercial financing for the remainder (30-35%). Any cost overruns beyond the EnDev subsidy were absorbed by the private owner, a risk mitigated by a close working relationship with the lending bank that was willing to provide more finance when the work came close to finalization. In the end, the three project developers received on average only 37% subsidy instead of the max 50%.

The investment costs for the three plants ranged from USD 4,000 to 4,750 per kW, with the largest plant (500 kW in Mazimeru) as the most expensive. The Mazimeru plant had to redo part of the construction, and in addition, it experienced problems with the utility reluctant to agree on a wheeling contract. The business plan was originally made considering the main power off-taker to be the tea factory where a wheeling contract would be signed with the utility to channel power through the grid and sell it to the tea factory. However, the setup was not accepted by the power utility, which brought considerable changes in the business plan.

The cost of the turbine was roughly USD 1,300 per kW, including the generator and the controls; the largest part of the costs was for civil work such as the weir and intake, desander, canal, and power house.

Taking into account the subsidy, the IRR for the plants was 15-20%. The commercial loans bear interest of 15-17% per annum and need to be paid back within 5 to 10 years. The return on own investment for the investors was higher, with payback times of less than two years. Since the micro-grids were not constructed, the companies now have their PPA contract with REG. Generally, the principle behind the REFIT is that the tariff is such that the plant itself should have an IRR of about 20%.

The community was actively involved in the design of the mini-grid. Several meetings were held with community leaders and the general population to request their feedback and consent, and inform and update them on the status. The work was planned in close coordination with district officials. A MoU was signed between the district mayor and the project developer prior to the development of a selected site. The district approved property expropriations that were necessary and supported land use arrangements. Community members were hired as paid labourers and this was a large source of local employment during construction.

Pricing and tariffs

In their original business plans the companies agreed on two principles: (i) pre-payment meters are necessary (in Rwanda this is now standard mode of operation for all grid customers; at the time of planning for the PSP hydro projects, this was not yet the case); and (ii) clients need to pay less than what EWSA clients pay. The EWSA end-user tariff was 112 RWF/kWh (+ 18% VAT) or about 0.24 USD/kWh, while the tariffs proposed by the micro utilities were around 100 RWF (+ VAT).

All new household clients, as well as institutional and industrial clients, have a pre-payment meter. The system is automated, and clients can purchase units in retail shops and offices. Detailed statistics are kept on the purchase details.

Lessons Learned

Although no stand-alone mini-grids were constructed as a result of the changing conditions in Rwanda, the concept offers relevant lessons:

- ✓ With limited technical assistance, partial subsidy, and conducive regulatory conditions, local private project developers are able to construct, finance, and operate simple hydro plants without major difficulties. After one plant is constructed, the capacity created is sufficient to construct a second plant without external assistance. This is in stark contrast with publicly (community) operated plants, which show considerable operational deficiencies in Rwanda, and which are not even able to raise the money for operation, maintenance, and repairs.
- ✓ Since there is no doubt regarding ownership of private plants, and project developers assume commercial debt to finance their plants, they must operate said plants or go bankrupt. This concept is solid and replicable across Africa.
- ✓ The regulatory framework must be conducive to private sector involvement: ownership rules, licensing, fiscal, and financial matters all need to be clear from the beginning.
- ✓ A developer should think more about demand than supply: it is always possible to develop the supply of electricity, at certain costs, but the demand should justify that supply. Commercial banks are willing to provide financing to private project developers for the construction of micro-hydro plants only if the plant is able to sell all the electricity.

  They insist that the project developer signs a PPA with REG and operates as an IPP. The banks consider the risk that multiple private and public clients could fail to pay their bills too high, which could indeed occur when the plant is only connected to a mini-grid. In other words, the banks consider mini-grids a poor value proposition, unless the project developer can demonstrate that he has reliable clients that are able to pay for their consumption. It is absolutely true that without a proper and viable business plan, the project developer cannot successfully operate a mini-grid. This is all too often ignored in (public) project design.
- ✓ In addition to a transparent and conducive regulatory environment, three conditions are necessary in order to scale up this model: (i) a subsidy mechanism; however, the level of subsidy is much lower than normally applied in public projects; (ii) a more open banking sector coupled with a guarantee mechanism would be very helpful and could mitigate the risk coverage, and hence ease loan access; and (iii) some TA capacity, certainly initially until the private sector has demonstrated that it is able to deliver the project development activities on their own.
- ✓ As the national grid extension was expected to be fast in this small country, it was always planned to connect plants and mini-grids to the national grid at some point in the future thus national grid technical standards have been applied to reduce upgrading costs in later stages.