Thematic Fiche no. 7

Sustainability - Business Models for Rural Electrification

One of the big hurdles in rural electrification is that supply to remote villages with low income is not economically viable. Therefore financial sustainability is a very important, as well as challenging, aspect of rural electrification projects and programs. Lack of organisational structures, high levels of initial capital investments, and lack of ability or willingness to pay by rural customers are some of the issues that make it challenging to develop a sustainable business model for rural electrification. Whereas equipment is often donated, bought and installed, the tariffs paid for the electricity are not high enough to ensure maintenance and reinvestment in the system.

The definition and classification of business models for rural electrification is challenging, and the criteria used for this classification is crucial. This Thematic Fiche presents different aspects of business models used in Rural Electrification. Specifically, it describes different types of organisation and ownership, financial structures and choice of customers. After this classification it looks into how the choice of technology influences the choice of the business model. In section 5 it examines different types of business models used in projects sponsored by the ACP-EU Energy Facility, and describes their experiences with these. Finally, it will evaluate if it is possible to define the most financially sustainable business model, and why such a model is not always chosen. Furthermore, the important issues to consider when designing the business model in a rural electrification project will also be outlined.

In this fiche electrification is understood as bringing electricity to customers. This includes developing a power generation scheme and logistics for distribution as well as an organisation for operating and selling the electricity, and a financial structure that is economical viable in the long run.

Aspects of Business Models

- Organisation and Ownership
- Financial Structures
- Choice of Customers

1. Organisation and Ownership

Often the choice of technologies is in focus when designing a rural electrification program, but the institutional factors can be crucial in determining whether a particular project is successful and sustainable.

Ownership and responsibility in rural electrification projects can cover different aspects of the projects. E.g. one actor can carry the responsibility of the initial capitalisation and development of the power system, another can own the generation capacity and the grid, and once it has been developed a third actor can run the operation, and carry the responsibility of maintenance and collection of money.

In the following, four different types of organisation and ownership are described, namely public utilities, private owners, NGO's, and Community Cooperatives.

1.1. Public Utilities

Most business models for rural electrification are characterised by the fact that the central government plays a key role. The central government must provide enabling legislation and regulations and support those who work to improve and develop rural electrification.

Central Utilities

In many countries, rural electrification is run by a public monopoly. The principal advantage of using a public utility is that the primary responsibility lies with an experienced actor, who has the financial resources and technical capacity to implement and manage the project. Moreover, their centralized position and large stock of spare parts give them the possibility to offer extensive maintenance. Another advantage is that a public monopoly can focus on the needs of the sector and impose strategic and cross subsidised tariffs – in this way areas where electrification is cheap and profitable can contribute to areas where electrification is very expensive and non-profitable. Furthermore, they can assess from a national point of view the areas in which grid extension is possible and recommendable and where non-grid electrification is the best solution.

The downside of a public monopoly is that they are often driven by political agendas, and that they can have a lack of understanding of specific regional and local needs. Moreover, the fact that there are no alternatives to the monopoly can be a problem in case they do not find it profitable to run services in some specific areas, or in case it is ineffective and expensive.

In several countries a central public utility has made the initial investment in power generation and nationwide grids, which is often not profitable for a private company. Later the generation and distribution has been privatised because these activities were more profitable and the private solution turned out to be more efficient in the long run. In some cases the public utility continues to own the grids, but they are used by private companies to distribute the power generated by the private utility.

Local Utilities

Smaller public utilities are well suited for rural areas. They have many of the advantages of the public monopoly but can at the same time act as a 'champion of the community' by bringing together the necessary participants and providing an institutional environment that protects the interest of the community and sets tariffs which are suitable for local costs. Local multi-service utilities can coordinate investments in other public facilities and projects and focus on the broad need of customers[1].

Rural Electrification Agencies

In several countries Rural Electrification or Rural Energy Agencies have been set up to strengthen the rural electrification effort. These are legally established and often semi-autonomous public agencies, whose main responsibility is to support the government in carrying out their rural electrification plans. In some cases this is done through public-private partnerships. Often the Rural Electrification Agencies work as the secretariat for a Rural Electrification/Energy Board, which holds the main responsibility of implementing the national plans for rural electrification including administration of the Rural Electrification Funds.

1.2. Private Owners

The participation of the private sector in rural electrification is based on the idea of attracting capital, efficient operation and new technologies for rural electrification. It can be argued that no matter who owns and runs the power plants there will always be a need for a local private marked in the energy sector to provide equipment, knowledge and maintenance service.

Problems with private owners arise when electrification is carried out in non-profitable areas, and subsidies are introduced. In developing countries, where extensive electrification is needed to support socio-economic and social objectives, it can be difficult to regulate competitive private utilities to meet those objectives. On the other hand, subsidies can be designed in such a way that it becomes economically viable to invest in the sector. In general, a well done rural electrification program must follow an economic logic and be able to attract private companies. System location and scale, income profiles of potential customers, as well as available subsidies dictate if private companies are interested.

Many rural areas in the developing world, however, are often characterised by a low ability to pay the actual costs of setting up an electrification scheme. It is therefore often difficult to find enough interested and qualified investors for these rural electrification projects. Hence, while the private investor model might in principle be the model with the greatest potential, it might also be the one most difficult to set up in practise. A central challenge is how to maximise private sector participation and minimise subsidies.

[1] "Rural Electrification With Renewable Energy – Technologies, Quality Standards and Business Models" and "Hybrid Mini-Grids for Rural Electrification", Alliance for Rural Electrification

As mentioned above it is relevant to differ between the initial investments such as the development of the power plant and the grids on one hand, and later generation and distribution of electricity on the other. Often the initial investment is not profitable, which makes it difficult to attract private investors without heavy subsidies, whereas the later generation and distribution is more financial attractive. Private actors can be central or local utilities as well as energy service companies (ESCOs) - which are normally government contracted, equipment dealers, or cooperatives.

A private sector model for rural electrification can take different forms according to the ownership of the system and the grid, the type of contract with end users, and the type of subsidies. A few specific examples are mentioned below.

Models for private energy supply

- Fee for service model: In this system the electricity provider owns the system and provides a service for the end users. It also ensures the operation, maintenance and replacement of the system, and in exchange the end users pay a certain sum every month for electricity. This system is very normal and can be used by both central and local power utilities.

- Dealer model: This system is mainly used for decentralised power systems such as household based PV systems. In this system the end-user buys the system from the dealer, and assumes responsibility of all operation and replacement costs.

- Lease model: This system is similar to the dealer model except for the fact that the equipment is leased to the end-user. At the end of the lease period, the equipment may or may not be transferred to the end-user. During the lease period the leaseholder remains owner of the system and therefore responsible for the maintenance and repair.

Concessions

One way to increase the attractiveness of rural electrification programs to private actors is by bundling the projects together. The most common form is geographical concessions where the holder of the concessions enjoys some beneficial terms for providing power services for rural communities living within a defined geographic area.

Investors

Investors, such as the local financing sector, are important actors in the private business model. As rural energy enterprises in developing countries are often seen as high risk, low margin businesses with high transaction costs, commercial banks and financial intermediates are often reluctant to support these investments and have to be instructed and encouraged to look into these markets. They must be familiar with the technologies and trust that power developers receive sufficient revenue to repay their loans.

1.3. NGOs

In developing countries, rural electrification projects, especially small scale non-grid electrification projects, are often sponsored by bilateral or multilateral donors, or international organisations. In that case, an international or local NGO can carry the responsibility of developing the power plant and the distribution network, and they will often hand over the responsibility of running the plants when they have been fully developed to a local public utility or a community cooperative.

NGOs will often be strong in community involvement, and will often have socio-economic as well as social objectives, meaning that they will work in areas where a private supplier would not work unless they were heavily subsidised. Moreover, NGOs will often work far away from the public grid, but along the rural electrification plan. This means that they will supplement the public rural electrification effort.

Challenges with NGO owned rural electrification projects are exactly the fact that these operate in non-profit areas. The initial capitalisation is often heavily subsidised, but financial sustainability is problematic as they work in areas with customers that are not able or willing to pay the tariffs for the electricity once the power plants are in operation. Often the tariffs are based on what the beneficiaries are expected to be able to pay or what they have earlier paid for alternative energy sources such as kerosene, and not what is financially viable. Subsidies for the tariffs are not a part of the project and maintenance and reinvestment in the power plants are therefore often not sufficiently budgeted for.

1.4. Community Cooperatives

Community based cooperatives, or co-owned power system, are mainly used for mini grid programs in isolated areas that do not attract private-sector or utility interest. Here the cooperatives become the owners and operators of the system and provide maintenance, tariff collection, and management services.

A strong feature of the community cooperatives is that the owners are also the customers, and therefore have a strong interest in the service and quality of the output. Furthermore, they are often less bureaucratic than public utilities, can create jobs in the local community, and make tailor-made tariffs for the customers.

Downsides with the community cooperative are that they often lack the technical skills to design and run the power systems and the business skills to implement a sustainable business plan. This model therefore requires substantial technical assistance. The local capacity for operation and maintenance needs to be assessed from the outset of a project, and a mechanism for allocating resources for operation and maintenance should be agreed on. This is also important in other types of ownership but is especially important for community cooperatives, as they take on a completely new task.

Another challenge with the community model is that there is a high risk of social conflicts within the community. Disputes of who has paid for what and who should benefit and at what price should be avoided through sociological, technical and economic approaches including the social shaping of the committees and the rules of leadership. In general, community owned rural electrification projects require a long preparation period and a great deal of technical and social capacity building to be successful.

1.5. Mixed

The mixed model, or hybrid model, combines the above mentioned organisational forms and ownership models, in the effort to benefit from the advantages of each model while at the same time minimizing their shortcomings. Mixed models are very common in rural electrification projects and the possible combinations are numerous. For example, the energy infrastructure can be owned by a public utility, a community cooperative can be responsible for the daily operation, while a private company can be assigned as a technical backup for maintenance. Collaborations like this take advantage of the strengths of each actor, which can potentially overcome some of the problems mentioned above. However, there are also downfalls. Involving numerous partners increases the complexity of the contract which can lead to misunderstandings and disagreement. Furthermore, such a setup requires a stable partnership between the different actors in order to secure the long-term sustainability of the project. Hybrid models are the most difficult ones to define and tend to be quite site specific[2].

1.6. Summary

The table below summarises the main advantages and shortcomings of the different organisation and ownership models described above.

[2] "Rural Electrification With Renewable Energy – Technologies, Quality Standards and Business Models" and "Hybrid Mini-Grids for Rural Electrification: Lessons Learned", Alliance for Rural Electrification

Table 1: Most common forms of organisations and ownership[3]

Organisation	Description	Advantages	Shortcomings
Public Utilities	A public utility installs, operates, and maintains the generation and distribution system and collects the tariffs	- Experienced Actor - Easier access to financial and technical resources - Potential to achieve economies of scale	- Political influence - Often inefficient - Lack of interest and commitment at the local level
Private ownership	A private company owns and operates the generation and distribution system, and collects the tariffs	- Private company may have a certain investment capacity and technical expertise - Driven by efficiency and performance	- Concerns only projects which are financially viable or almost financially viable - Implies access to finance - Company needs high technical and managerial competences
NGOs	An NGO installs and operates the generation and distribution system through donor funding	- Can work in areas where it is non-profitable to invest in rural electrification	- Sustainability can be a challenge
Community Cooperatives	The community organises itself and sets up a cooperative that own and operate the generation and distribution system	- Positive impact on the community in terms of self governance and local interest in the electrification system - Strong interest in the long term maintenance of the system	- Long preparation time and need for technical and social capacity building - Risk of technical and financial failure over time - Subject to pressure from community / specific community members
Mixed	- Mix of previous models - Ownership and operation can be differentiated and different actors can generate and distribute the electricity - All previous stakeholders can be involved	- Combination of the advantages of the different systems	- Complexity of agreements - Need for stable partners

2. Financial Structure

2.1. Tariffs

Another fundamental part of the business model of a rural electrification program is how the expenses of the project are covered, and how tariffs are calculated. Tariffs should at least cover the running costs to ensure the operation of the system through its lifetime and should recover the cost imposed on the system by customers. Ideally the tariffs should also cover replacement of the system once the lifetime is over.

[3] This table has been inspired by Alliance for Rural Electrification:"Rural Electrification with Renewable Energy – Technologies, Quality Standards and Business Models".

Setting the tariffs is often a complicated exercise. The tariffs should be structured so as to balance both sustainability and affordability. In projects, where the initial capitalisation is heavily subsidised, the main focus on calculating the tariffs are often affordability and willingness-to-pay, and the tariffs are at best break-even-tariffs. In these cases, the avoided costs such as the price of other energy sources like kerosene and candles are used when calculating how much the customers are willing to pay. Affordability is a very important part of tariff-setting, but has to be weighed against sustainability, which is not always done in heavily subsidised projects.

Most often the tariffs in the rural electrification projects have two Components:

- Connection fees: These are normally used to cover the cost of meters/poles, and to recover parts of the upfront investment cost. Added objectives can be to test the commitment of the customers and prevent excessive demand on the system.

- Consumption fees: These are paid on a monthly or yearly basis, and will most often vary according to the level of electricity consumed.

To ensure sustainability, two main types of tariffs are relevant:

- Break even tariffs: These are designed to cover operating, maintenance and replacement costs. This type of tariff is mainly used in community owned systems, where the initial investments costs and the connection fee are heavily subsidised.

- Financially viable tariffs: These are designed to allow for a sufficient return of the investment to attract private investors. This tariff is designed to cover all system components.

Tariffs schemes

There are two broad categories of tariff schemes, namely energy based tariff systems and a system based on expected power consumption.

Energy based tariff systems: The tariff is established according to the energy consumed during a billing period. A meter provides the customer with information of how much electricity is used. This gives strong incentives for energy conservation. The challenges of this system are that meters are quite expensive and an organisational system needs to be put in place to read the meters in each billing period, which can influence the running costs. An alternative to conventional meters is pre-paid meters, where the customers purchase units of electricity in advance – when they run out of units their supply shuts down. This has the advantages that the organisational system for reading the meters can be saved, and overdue payments are avoided. On the other hand the expensive meter and an advanced organisation for local sales of the pre-paid meters are still needed. New technologies where the customer for example uses a mobile phone for reading the meters and reporting on energy consumption, as well as for purchasing pre-paid units have been introduced and tested. This might decrease the operating costs of both systems considerably.

A special version of the energy based tariff system is the Graded Tariff system in which the first kWh used is cheaper than heavier consumption.

Often the energy based system is supplemented by a fixed monthly or yearly charge covering the connection cost.

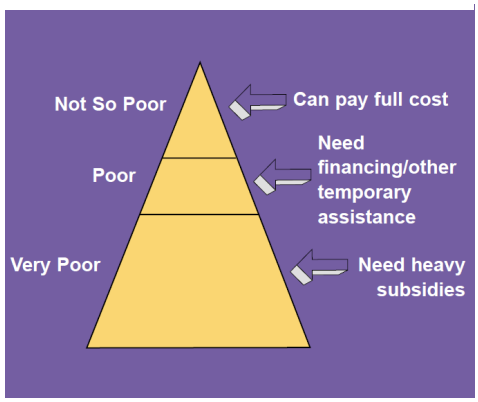
The expected power consumption tariff system: In this system the power available to the customers is pre-determined, and payment is made on the basis of this level. Often more levels are possible so customers with higher demand buy a higher level and pay more. The advantage of this system is that expensive meters are not necessary, and that the customers know in advance how much they are going to pay. The disadvantage can be that there is no incentive for energy saving, that the electricity available for the customers is limited, and that the system has a risk of being overloaded. Moreover abuse can be difficult to avoid. One way to overcome abuse as well as system overload is the introduction of load limiters, which limit the current entering the houses. Load limiters are much cheaper than normal meters.

For both tariff schemes the payment system should be clearly defined and understood by the customers, and the collection of the tariffs should be enforced to ensure that customers take it seriously.

2.2. Subsidies

Subsidies can be given by state agencies, donors or organisations involved in a project in order to make an energy system affordable for the end-users, and at the same time ensure financial viability of the power system. If properly used and designed, subsidies can be an effective way to overcome market imperfections and give private investors the incentives to enter into a high risk rural electrification market. On the other hand it is crucial to design subsidies with careful attention to the danger of market distortion. A viable exit strategy is crucial to ensure sustainability of the project.

Figure 1 – Subsidy targeting



Subsidies must be designed so as to target the people they are intended to support. If a project aims at rural electrification for all it may be necessary to strengthen the buying power of the poorest part of the target population instead of giving flat rate subsidies to all[4].

[4] Figure from: "Expanding Electricity Access to Remote Areas: Off-Grid Rural Electrification in Developing Countries", World Bank

Types of subsidies

In the table below the most common forms of subsidies for rural electrification are listed, with descriptions as well as advantages and shortcomings.

Table 2: Most common Subsidies for rural electrification[5]

Subsidy	Description	Advantages	Shortcomings
Investment Based	Capital subsidies targeting the overall initial investment. These are often given by the state or donor organisations to the project implementers	- Supports only economically viable projects - Supported by main donor organisation - Easy to implement	- Implies cost reflective tariffs - Operation and maintenance is not guaranteed - Pure give-away programs might harm the local private market
Connection Based	One-time subsidy granted according to the number of connections, either from the state or donor to the project implementers or directly to the customers that will be connected to the grid	- Incentives for investment and for maximising connections in very scattered areas - Mobilisation of capital and entrepreneurship - Avoids illegal connections that can lead to system overload - Planning of the system capacity is easier if you know the number of connections	- Risk of systems being overstretched with too many connections. - Implies cost reflective tariffs - Harder to implement, requires stable legal, financial, and political environment
Output Based	- Subsidies supporting the electricity producers - Most output based subsidies are transition measures to help bridge the gap between the revenues and the costs	- Strong incentives for mobilisation of private capital and entrepreneurship - Safeguards operation and maintenance	- Requires stable refinancing either through cost-splitting, state budget or special funds - Has to go in parallel with private sector development objectives - Harder to implement, requires stable legal, financial, and political environment
Lifeline Rates and Cross subsidies	- Lifeline rates: subsidising energy use for the poorest customers - Cross- subsidies: Tax or tariffs imposed on the richer or "bigger" customers to subsidise poorer or "smaller" customers	- Effective instrument for encouraging rural customers to use electricity - Good potential source of revenue for rural electrification and good instrument for social justice	- Lifeline rates can be set too high compromising the financial viability of the rural energy companies. - Cross subsidy can limit the consumption of "bigger" users
Operation	- Subsidy to the owner supports the operation of the system but not the initial investment - Bridges the gap between affordability and cost recovery	- Ensures operation and maintenance - Helps to secure revenue for the private sector and gives incentives to mobilise private capital and entrepreneurship	- No incentive to achieve economic sustainability - Harder to implement, requires stable legal, financial and political environment

To ensure financial sustainability subsidies should be minimised as much as possible, and should mainly be given as Investment Based and Connection Based subsidies. Output Based, Lifeline Rates, and Operation subsidies do not properly

[5] Table from: "Rural Electrification with Renewable Energy – Technologies, Quality Standards and Business Models", Alliance for Rural Electrification.

reflect the actual cost of the electricity, and could lead to inefficient electricity use, thus should if possible be avoided. Cross subsides can, if properly used, be a good way to ensure financial sustainability and affordability for the poorest customers.

Indirect subsidies

Besides these conventional financial forms of subsidies a long list of indirect subsidies or business development support can be used. Often the project donors will support the owners of the generation or distribution facilities through training in marketing, operation and maintenance, technical assistance, and analysis surveys and studies. Finally public initiatives such as reduction or exemption of investment and production taxes and import duties can have a big influence on the financial viability of rural electrification projects.

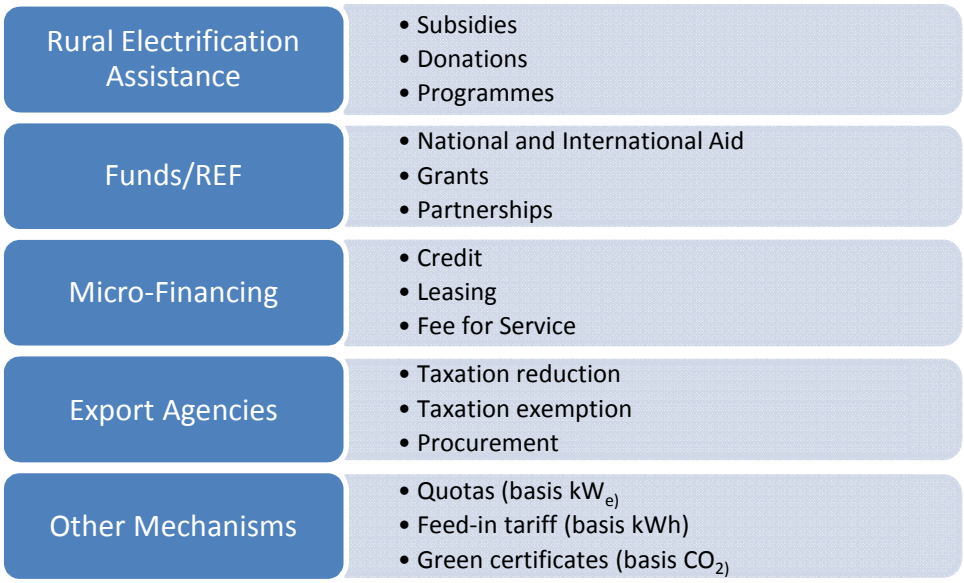
Sources of subsidies

The main sources of subsidies are the governments in the countries where the project is implemented, development organisations, funds and private investors such as utilities through cross subsidies, dealers through lease of equipment and micro finance institutions.

In several countries Rural Electrification Funds have been established to coordinate donor support for rural electrification and to ensure that it is carried in accordance with the overall national plan. The purpose of the REFs are to make rural electrification projects financial viable, and at the same time keep the tariffs at an affordable level. The REFs are often used to boost public-private partnerships.

The figure below shows a range of subsidy sources and promoters of rural electrification programs.

Figure 2 - Sources of rural electrification subsidies[6]



[6] Figure taken from: "Hybrid Mini-grids for Rural Electrification: Lessons Learned", Alliance for Rural Electrification.

3. Customers

The choice of customers is also an important part of the rural electrification business model. In general one can distinguish between 1) Domestic users, 2) Productive users and 3) Public users.

The domestic users are often the major group, but might also be the less profitable one. Therefore a rural electrification program could target productive users such as SMEs and local industry. This can have a positive impact on the development aspect of the program, and can increase the prospects of long term sustainability of the project through direct generation of revenues. Especially businesses already in the area covered by the program currently relying on other forms of power generation show a need and a willingness to pay for an alternative reliable electricity service.

Including public institutions with a potentially large size of installations can increase the profitability of rural electrification projects if they have money to pay for the electricity. In some projects they are included for community development reasons.

Often a mix of customer groups will be the most common solution.

4. Technologies and the choice of Business Model

Often the choice of technology will influence the choice of business model. Some business models will be more suitable for grid systems, and others will be suitable for non grid systems. For example the dealer model and the lease model are most often used for non grid decentralised systems.

The choice of tariff system will also be influenced by what is technically feasible. E.g. an energy based tariff system needs a system for measuring the energy consumption in one way or another. This means that the expected power consumption tariff system might be more appropriate for small household based renewable systems such as PV systems.

Projects designed as non grid systems might need to change business model in case the national grid reaches the area the project work in. This can influence the tariff and management structure, and it can be necessary to plan in advance how to adopt to this situation.

In project development the choice of technology is often taken very early in the process, and it is often considered a very important aspect of project design. One should be aware that the technical solutions adapted especially in non grid systems can have an impact on the range of possible business models.

5. Experiences – ACP-EU Energy Facility projects

As addressed above, organisation and ownership, financial structures and choice of customers are essential aspects of creating a sustainable business model. The ACP-EU Energy Facility projects have quite different approaches to the business model.

Below a series of case studies of selected ACP-EU Energy Facility projects are presented illustrating different approaches to financial sustainability. The case studies have been produced on the basis of project reports and phone interviews carried out in early October 2011. Six projects were interviewed based on the different business models they were using, and 4 of these are presented in the subsequent cases.

5.1. Energy Facility: Examples of Different Business Models

Project	Business Model
Cross-Border Supply of Electricity to Rural Communities in Togo, 9 ACP RPR 49/37 **and** **Cross-Border Supply of Electricity to Communities in Burkina Faso, 9 ACP RPR 49/39** **Countries of the project: Regional Projects in West Africa, covering Ghana, Togo and Burkina Faso.**	**Project Outline:** Cross-border power grid extension from Ghana to Togo and Burkina Faso. The aim is to provide access to electricity for 42,500 people in Togo and 32,393 people in Burkina Faso – households, companies, industries and social services. **Organisation and Ownership:** Both projects are implemented by West African Power Pool, which is an International Organisation, in cooperation with public utilities in the countries of intervention (Electricity Company of Ghana, Volta River Authority (Ghana), Compagnie Energie Electrique du Togo, Communaute Electrique du Benin (Benin/Togo) and Société Nationale d'Electricité du Burkina Faso). The public utilities have financed the part of the project (about 50 %) not sponsored by EC, and they will take over the grids once they are in place. The grids are connected to power plants already owned by public utilities in Ghana. **Financial Structure:** For the **Ghana-Togo** project a Power Purchase Agreement (PPA) has been developed between Electricity Company of Ghana (ECG) Ltd and Communauté Electrique du Benin (CEB). The CEB is by law the company mandated to handle cross border or international electricity transactions in Togo and Benin. The PPA is a freely negotiated contract between ECG and CEB, and it has been decided, that ECG will sell to CEB at the same price that ECG sells to an Industrial Customer in Ghana. Electricity bought by CEB is then sold to Compagnie Energie Electrique du Togo that distributes the electricity to domestic, commercial and industrial customers. The tariff structure in Togo for these costumers is determined by the Regulator in Togo. For the **Ghana-Burkina Faso** project Volta River Authority (Ghana) sells directly to Societé Nationale d'Electricite du Burkina (SONABEL), based on a negotiated tariff. SONABEL sells the electricity to customers in Burkina Faso at the National Tariff determined by the Regulatory Authority. The customers pay no direct connection fee, the service connection fee is paid from the project budget, but in Togo they have introduced a 6-month pre-payment in order to get connected. Since the connection is free, the beneficiaries as a sign of good will voluntarily decided not to claim compensation for trees and crops destroyed to make way for the transmission lines. The project uses a normal meter system, as pre-paid systems are considered too expensive. The public utilities have local offices, with staff reading the meters, and sending the bills to the customers. If the bills are not paid the customers are disconnected. The project is only subsidised by the EC. In the rural areas the public utilities do not break even, so the project is not financially viable in the short run. The grid extension would not have been implemented without subsidies from the EC for the investment cost, and without cross subsidies from peri-urban and urban areas. The investment is moving towards cost recovery, and the project is expected to become economically viable in the long run. **Choice of Customers** The selection of benefitting villages is done using geographical criteria such as distance to the grid, as well as what is technically feasible. All people living in the benefitting communities can in principle get electricity if they can pay the deposit against future consumption and have the internal connection needed to be connected to the grid. Most businesses in the areas are placed in the centres of the towns, and will therefore be connected.

Msamala Sustainable Energy Project, 9 ACP RPR 49/29 **Country of the project: Malawi**	**Project Outline:** Community development and provision of biomass and solar power to poor subsistence-farming households and schools in 321 communities. The project is based on heavy community involvement, where beneficiaries identify their own challenges and suggest solutions for the problems. These suggested solutions lead to micro projects. There are several components in the project. The main component includes formation of business groups out of community members. The business groups will be trained in viable new enterprises, and will be linked with financial lending institutions. Another component, which will be the focus here, is provision of solar power to rural schools and houses for teachers. **Organisation and Ownership** The solar power systems are given to the schools as grants from the project after they demonstrate ability to sustain them. They are managed by the School Committees or Parents/Teachers Association which takes care of running and maintaining the solar systems. The maintenance is paid by a Maintenance Fund which is administered by the Committees. **Financial Structure** The community can contribute to the Maintenance Fund through cash or in kind contributions. The types of contribution vary from school to school. Types of contribution can be: 1) Parents are asked to contribute 2) Electricity generated by the solar systems is sold during non peak hours, e.g. for charging mobile phones when the schools are not used. 3) The committees carry out income generating activities where the money goes to the Maintenance Fund. Examples are entertainment shows where tickets are sold or constructions of fish ponds and vegetable gardens where the crops are sold. 4) Teachers pay a monthly fee for the electricity they use in their homes in form of adjusted school staff house rentals. The fee is decided by the Committees. In the beginning the beneficiary schools did not pay anything for the solar panels, but lately the project has asked the schools to make an upfront contribution to show commitment. The upfront contribution it put into a bank account which they open for the Maintenance Fund. The Maintenance Fund should be large enough to buy spare parts, and to replace parts that are stolen. The Committees have the responsibility of replacing stolen equipment, but in case where this is not possible they can ask the District Council for assistance. The financial viability of the project will depend on the Committees ability to fundraise for the Maintenance Fund, and in several communities the level of fundraising is currently not high enough. **Choice of Costumers/Beneficiaries** The schools are chosen as demonstration projects, and the solar systems are part of a strategy to get qualified teachers to the rural areas. It is a solution to a literacy problem, and not meant as a rural electrification business. The demonstration project is implemented to show the public officials how important electricity/solar panels are to get teachers to the rural areas, and it is the hope that they will in time use their rural electrification funds for this kind of standalone solar systems for remote schools. Criteria for which schools are chosen are: remoteness, capacity of the School Committees, security/risk of thefts and ability of the community to fundraise.

Catalysing Modern Energy Service Delivery in Marginal Communities in Southern Africa, 9 ACP RPR 139/3 **Countries of the project: Malawi, Mozambique, Zimbabwe**	**Project Outline** Micro- hydro schemes developed in Mozambique, Malawi and Zimbabwe to provide electricity to marginalised communities in the three countries. The project has developed three business models – one for each country. The models were developed in cooperation between the communities involved and the Business Development Advisor for the implementing organisation, Practical Action, and the choice of model has been influenced by the communities' tradition, experience and wishes. **Organisation and ownership** **The ShareD (Shares for Dividends) Model – Zimbabwe** The ShareD Model is a community cooperative designed as a private company comprising of ownership in shares and a management body that will run the operation of the scheme. The shares are distributed to members of the community, based on how much they have contributed to the development of the scheme in kind or in materials. Most households that connect to the scheme pay 100% connection fee, but customers which the community declare vulnerable can be connected on a grant basis. **The Generator Model – Mozambique** In this model a private investor owns and runs the power generation scheme. Half of the initial investment is given to him as a grant, and the other half has been obtained as a loan from Practical Action, which he will pay back to a community-managed revolving fund established for this purpose. He will repay his loan through the tariffs he gets from the customers. The transmission and distribution equipment is also paid 50 % by the project, and in most cases this is owned by the community. The private investor pays a fee to rent the equipment from the community. This setup is properly chosen as a control mechanism to ensure that the individual generation entrepreneur will not become a monopoly. The private investor runs the scheme as a profit-making business. **The BOT (Build, Operate and Transfer) Model – Malawi** In this model Mulanje Mountain Conservation Trust´s energy agency called Mulanje Renewable Energy Agency MMCT/MuREA is one of the partners implementing the project. They adopt the scheme for the first two to three years, after which the scheme will be partly transferred to the community. The community will manage and operate the scheme under guidance from MMCT/MuREA until ownership and management is partly transferred to the community through a community cooperative. This model is good in situations where the community is not willing to participate in the construction of the scheme, and where the investor feels that the community needs more time to appreciate the full benefits of the scheme. It allows the investors to focus on the development of the scheme with hired labour while putting the ownership model in place. The model can be implemented in different ways. One example from Malawi includes a community cooperative represented by a Board of Trustees. Below that is a Company Board of Directors. These have professional qualifications such as accounting. Below this board are the technical people who are trained to run the specific day to day duties. Over and above all this, an Advisory Board is comprised of promoters of the technology.

Financial Structure

It goes for all of the business models described above, that financial sustainability has been the central point in developing the models.
In all models the grant from EC partly covers the initial investments' cost; the rest is covered by private persons either as one private entrepreneur or as Community Cooperatives. Each project has two trust funds. One that covers the grants given and one that covers the private investments. Surplus from the first trust fund is reinvested in the community e.g. as grid extensions or other social services. Surplus from the second fund goes to the private investors, and can if they chose to also be reinvested into the power system, but can also be withdrawn for private use.

In Mozambique the private investor use a graded tariff system based on how much the customers are able to use. This is predefined by their installed capacity. A flat tariff has been set, depending on the number of electrical appliances. This model has been chosen because the owner prefers predictable payment, instead of payment after consumption, and depending on when the customers are able to pay. The tariff is fixed, and follows the government structure. It is a bit below what is financially viable.

In Malawi and Zimbabwe great effort has been put into calculating the minimum break even tariffs using a tariff calculation model. The minimum break even tariff covers operation and maintenance including salaries, spare parts, the billing system, stationeries etc. The tariff also covers replacement of the scheme within 25 to 30 years. The communities can chose to set a lower tariff that does not cover replacement. In that case they have to come up with another plan to cover this cost. They can also decide to go above the minimum tariff and gain a surplus that can be reinvested into the system. So far no communities have gone below the minimum break even tariff. The tariff set in all communities are currently a little above the public tariff.
The experience from the project is that the customers are willing to pay, even though the tariffs are a bit high, if alternative payment methods are introduced. Methods for payment vary from one community to another, and include pre payment methods such as scratch cards like for cell phones. They are also experimenting with seasonal payment, and payment in commodities. If electricity is not paid it is switched off.

In all countries there is some form of cross subsidies, where the "bigger" or more business oriented customer subsidise the "smaller" customers. E.g. in Malawi and Zimbabwe the commercial customers pay a higher tariff than the households, and the schools and clinics.

The project is subsidising investment cost and training but not the tariffs. In a few cases they have helped out the communities if some spare parts need replacement, but in general they try to avoid interference in maintenance of the schemes.

Choice of Customers

Customers for the electricity grid are chosen through an inclusive process. The community is gathered, and develops a master plan for the grids. After that they decide what they want to prioritise, which is normally first schools and clinics and then households. Practical Action points up the facts they need to consider in order to decide on a viable business plan. E.g. the cost of each grid and the number of customers for each grid. From a business perspective it is a good idea to get many well paying customers connected from the beginning and then reinvest the money from their consumption fees into other less profitable grids.

Mwenga 3 MW Hydro Power Plant, 9 ACP RPR 139/15 **Country of the project: Tanzania**	**Project Outline** The aim of the project is to develop a 3 MW hydropower plant on the Mwenga River and to connect a tea factory and 14 villages to this electricity supply. The tea factory is paying the part of the project not financed by EC (about 51 %). **Organisation and Ownership** The project has established two private companies which will operate the generation and distribution equipment once the project has been constructed. In the long run, Mwenga Hydro Ltd (GENCO) will generate and sell electricity to the Rural Power Distribution Ltd. (DISCO), which will transmit, distribute and sell electricity to rural customers. GENCO will also sell electricity directly to TANESCO – a national owned power company which can buy the surplus electricity, and to the tea factory which is the co-financer and one of the implementers of the project. The reason for the division of tasks between generation and distribution in two different companies is that these two tasks require different skills and expertises. The project has decided to develop these two private companies as a part of the project as they could not identify existing private utilities that would be willing to take over the generation and distribution in the rural areas the project wanted to cover, because they did not find it profitable. **Financial Structure** The power schemes are not yet operating, but in time the customers are expected to pay a connection fee expected to be less than half of the actual costs. The project will use the national electricity tariff, as this is appreciated by the government and the National Regulator. Two different tariffs will be established: D1 which will be paid by small customers – mostly households - using less than 50 kWh, and a higher tariff T1 to be paid by commercial customers and public institutions. The expectation is that customers over the long run will move from the D1 to the T1 tariff for higher use. The ACP EU Energy Facility programme is subsidising the project by co-financing the first 2600 connections within the new Rural Network. From there on the investors expect at least to break even through cross subsidies from the T1 customers to the D1 customer. As many D1 customers are expected to become T1 customers over time. The national tariffs are a bit low, but with subsidies for the first 2600 connections, and with low running cost of a hydro power scheme, the tariffs will break even and be able to cover replacement costs of the scheme within 30-35 years. When the project was designed the project implementers expected to use a prepayment system using load limiters, but this idea has been given up for two reasons. Firstly, load limiters could hinder development by limiting how many electrical appliances the costumers can use. Secondly, new technologies have now entered the market, allowing a cell phone based prepaid system to be introduced in the project. In this system scratch cards are sold by vendors who collect the scratch cards at a central office and earn a percentage of the sales through a sales commission. This system is cheap to run compared to a system where money had to be collected by officials across a 750 square kilometre area. Moreover the project implementers have the impression, that prepayment systems will likely limit electricity thefts, as it introduces a new mindset to electricity payment, and also has the ability to identify locations of misuse of the system (before it develops and takes root). The only challenge of this new system is that it needs a reliable tele-communication system, which might be a challenge in some rural areas. The system has just been introduced, so it remains to be seen how it will work. **Choice of Customers** Once the scheme is operating it is expected that the major customer will be TANESCO, who expects to buy about 80% of the electricity. The rest will be sold to the tea factory (about 10%), and to the rural communities (about 10%). Once the rural network has grown larger, and purchasing power in the rural communities has risen as expected, the goal is that the share for the rural communities will rise to above 50 %.

5.2. General experience from case studies

Even though the case studies above are very different, it is possible to draw a few general conclusions.

1) The choice of ownership structure is often influenced by the way the implementing partner normally works. Many NGOs work with community cooperatives, and see this as a natural way of doing things, whereas a private partner will often choose a private utility to run the business once the project has been implemented. Often the type of ownership is predefined, and not something considered part of the business model and sustainability plan to be developed during the course of the project.
2) Customers are in some cases chosen based on need and social arguments instead of a business point of view. There are often valid arguments for this approach, but it might not be the most financially sustainable choice.
3) Tariff setting is often the most challenging part of developing the business model. Often it can be difficult to measure exactly what the break even tariff is, and what it will cost to replace the scheme in e.g. 30 years time. The challenge of weighing affordability and willingness to pay against the most cost effective tariff is also difficult. In many cases the communities decide what the tariff should be, and it is important that they have the information needed to take an informed decision and to choose a financially viable tariff.
4) In several cases the projects had to use the national tariffs. There were different reasons for this, but it can be a challenge that the projects are not allowed to choose the financially most viable tariff.
5) Affordability is not necessarily the same as willingness to pay and some projects have experienced that it is more important to make it easy for the customers to pay than to set low tariffs. This can be done in a variety of ways. Several of the project implementers interviewed indicate that pre payment systems is the way to go, as this hinders misuse of the system, and makes the cost of electricity more predictable for the customers. In this way they can simply buy electricity when they have cash. New technologies, e.g. cell phone based systems can make the prepayment system cheaper to implement.
6) The business models vary a lot from project to project and in some cases from community to community. It is important to choose a model that fits the community implementing the project, and a long variety of mixed models have been introduced. In several cases the project has changed their business model along the way as they gain experience during project implementation.
7) It can be a challenge that other projects in the region sell electricity at heavily subsidised tariffs, as this creates frustrations when a project asks the customers to pay a financially viable tariff. Moreover some projects mix grants and loans, and this can - if not properly handled - send mixed signals to the owner and the customer. It is important that repayment of loans and payment of tariffs are taken seriously and that lack of payment is sanctioned.
8) Choosing customers and beneficiaries can be a challenging and, in some cases, very frustrating exercise. Community involvement is a way to overcome this. Moreover Energy projects with heavy community involvement

can have positive spill-over effects to other development issues such as business understanding and general involvement in community planning.

6. Conclusion

Is it possible to define the ideal business model for rural electrification? The answer to this is 'no'. What the best model is depends on a long range of local circumstances, and what might work at one time in one country can be ineffective in another. Thus there is no "one-size-fit-all" solution. There are, however, some guidelines on what is important to consider when designing the business model.

1) All organisational structures have weaknesses, and will need capacity building to overcome these.
2) To ensure sustainability the local capacity for operation and maintenance should be assessed from the outset of a project, and a mechanism for allocating resources for operation and maintenance should be agreed on.
3) Tariffs should be set to balance affordability and willingness to pay on one hand and the real costs associated with electricity supply on the other. They should as minimum break even. Tariffs should be clearly defined, easy to understand for customers, and sanctions should exist if tariffs are not paid.
4) Subsidies should be designed in a way that avoids market distortion and ensures a viable exit strategy. In general investment and connection subsidies can be a good way to overcome the challenge of electrifying areas that are not profitable in the short run, but subsidies for the operation should be avoided as the tariffs need to reflect the real costs of running the schemes. Indirect subsidies and cross subsidies can both be ways to make a project financial viable in the long run.
5) Methods of payment can influence willingness to pay. It is important to make it easy for the costumers to pay for the electricity, both by making it practically feasible and by allowing the costumers to pay when they have cash. Ideas for alternative payment methods are prepayment systems based on scratch carts and seasonal payment where costumers pay when they harvest.
6) The mix of customers can influence the profitability of the project, and it can be a good idea to design the project in a way that ensures the electricity is used in a productive way[7].
7) Providers of off grid electricity need from the outset of the project to plan for what will happen once the grid reaches the areas they work in, and how the off grid system can complement, or be integrated in the grid system. This includes considerations of buy back systems, and changes in tariffs and management systems.

In practise it is clear that many projects do not follow these guidelines, often resulting in financial unsustainability. The question is why a less than optimal business model is often chosen. There can be several reasons for this:

[7] For more information about productive use of electricity see Thematic Fiche nr. 2 "Modern Energy Access for Economic Development."

1) Lack of local knowledge, such as lack of a proper baseline study and need assessment.
2) Political interference e.g. on the tariffs or a development agenda focusing the effort in an unprofitable direction.
3) Lack of business capacity of project implementers, such as the capacity to set the right tariffs and choose the right combination of subsidies.
4) The business model is chosen from tradition and social argumentation instead of a business perspective.

The case studies above have shown that the business models chosen have different advantages and short comings. In general the most financially sustainable projects have been designed in a business oriented way, and have a financial structure which resembles the structure that would be used by a private company.

Useful links

1. ACP-EU Energy Facility Position Paper on Rural and Peri-Urban Electrification, dealing with the problem of lack of investment, including the financial issues of rural electrification: http://ec.europa.eu/europeaid/where/acp/regional-cooperation/energy/documents/rural_and_periurban_electrification_position_paper_en.pdf
2. Report by Alliance for Rural Electrification (ARE) on "Hybrid Mini-Grids for Rural Electrification: Lessons Learned" with a focus on creating sustainable business models for rural power mini-grids: http://www.ruralelec.org/55.0.html?&tx_ttnews%5Btt_news%5D=119&tx_ttnews%5BbackPid%5D=43&cHash=e6406bc40b
3. Report by Alliance for Rural Electrification (ARE) on "Rural Electrification With Renewable Energy – Technologies, Quality Standards and Business Models": http://www.ruralelec.org/fileadmin/DATA/Documents/06_Publications/ARE_TECHNOLOGICAL_PUBLICATION.pdf
4. Guide created by the World Bank Group on "Designing Sustainable Off-Grid Rural Electrification Projects: Principles and Practices" with a focus on the role of the private sector: http://siteresources.worldbank.org/EXTENERGY2/Resources/OffgridGuidelines.pdf
5. Asian Development Bank paper on utility tariff setting with an emphasis on economic efficiency and financial sustainability: http://www.adb.org/Documents/ERD/Technical_Notes/TN024.pdf
6. Paper from Stanford University "Making Small Work: Business Models for Electrifying the World: http://iis-db.stanford.edu/pubs/21983/WP63,_Zerriffi,_Making_Small_Work_20070926.pdf
7. Paper on "Expanding Electricity Access to Remote Areas: Off-Grid Rural Electrification in Developing Countries" http://martinot.info/Reiche_et_al_WP2000.pdf
8. Report on rural electrification from Cigré, a non-profit organization on electric systems, with a focus on experiences with improving the performance of rural

electricity projects. http://www.cigre-c6.org/Site/Publications/download/Scoping%20report_rural%20electrification_WG%20C6.13ID44VER11.pdf

9. The African Electrification Initiative webpage includes relevant information about business models. This can be found by a search through Google
10. The software HOMER, which is an Energy Modeling Software for Hybrid Renewable Energy Systems: http://homerenergy.com/
11. The WB AEI Programme: http://go.worldbank.org/WCEDP90SZ0

Thematic Fiche No. 7 "Sustainability - Business Models for Rural Electrification"

European Union Energy Initiative (EUEI)
http://www.euei.net

ACP-EU Energy Facility
http://ec.europa.eu/europeaid/energy-facility
E-mail: EuropeAid-Energy-facility@ec.europa.eu

Monitoring of the ACP-EU Energy Facility
http://www.energyfacilitymonitoring.eu
E-mail: acp_eu_energy_facility@danishmanagement.dk