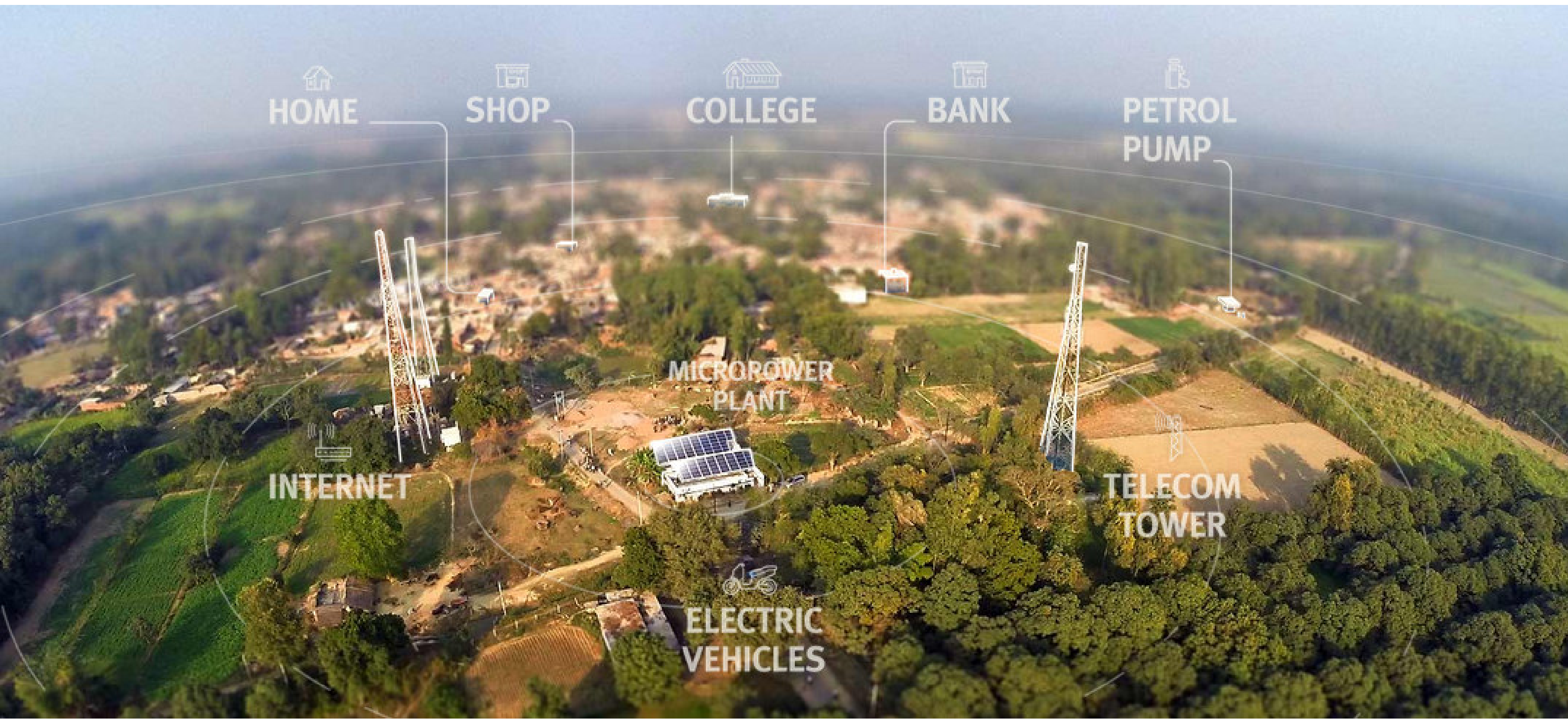
Institutional Development for Energy in Afghanistan (IDEA)

(PN 15.2000.6-001-00; VN 81188123)

Business Models for Operation and Maintenance of off-grid Power Supply systems



By Dr. Thomas Meier, GFA Entec AG

Final Report submitted Oct. 1, 2016

TABLE OF CONTENTS

1 INTRODUCTION

Afghanistan is struggling with access to energy for its population and effective energy provision, particularly in rural areas. The numerous institutions tasked with energy provision and related management face a number of challenges: Insufficient and inefficient power plants, the ongoing deterioration of the security situation and dependency on (costly) energy provision from neighboring states. The overarching legal framework has been put in place. However, there is little cooperation among the various institutions involved in the energy sector who face unclear and overlapping mandates and diverging interests. Against this background GIZ launched the program IDEA (Institutional Development for Energy in Afghanistan) in 2015. The main objective of the program is to improve the framework conditons for enhanced energy supply. The objective requires various adminitrative reform measures, including organizational and capacity development in the energy sector.

GFA Consulting Group has been contracted by GIZ to support the implementation of the IDEA project with a particular focus on organizational development within the Ministry of Energy and Water (MEW). The present report contributes to the development of regulations for off-grid power supply systems (Component A) as well as to identify business models for increased private sector participation in operation and maintenance of such systems (Component D).

1.1 Background

Afghanistan's consumption of electricity is one of the lowest in the world. In November 2012, the Ministry of Energy and Water (MEW) estimated the country's household electrification ratio with 28%. The vast majority of connections are in urban centers. The electrification ratio in rural areas is estimated to average around 10%. The Power Sector Master Plan (IROA, 2013) has set ambitious targets: until the year 2032 the electrification ratio in rural areas shall reach 65% and in urban areas nearly 100%.

A number of policies have been drawn up to explain how these targets shall be reached. For rural areas which are unlikely to be reached by the national grid in the medium-term, the development of village mini grids is strongly supported. The involvement of the private sector in building and operating these mini-grids is a strategic objective and financial support shall be made available to reach targets.

While the willingness is clearly expressed in the national policies, a concrete regulatory framework remains to be developed. The practical tools required for the implementation of mini-grids such as tariff regulations, standard concession contracts and PPAs are yet to be developed.

1.2 Objectives

The objective of this paper is to provide an overview of different business models for operation and maintenance of mini-grids in rural off grid areas. Such business models will be discussed based on case studies from different developing countries. The idea is to give the Government, donors, and the private sector a better understanding of the different possibilities how to develop, finance and operate mini-grids including the advantages and disadvantages of each option and the roles of the different stakeholders. Based on such understanding, it will be possible to select a preferred option to operate mini-grids in off-grid areas in Afghanistan. This will be a strategic decision based on which the required regulatory changes can be made in the next step.

1.3 Structure of the Report

In a first step we will review the policy and regulatory framework in Afghanistan with regards to off-grid electrification strategies and targets, the role of the private sector, tariff policy, and project financing (Chapter 2).

In the second step, a classification system of possible business models will be presented. A number of case studies from other developing countries will be presented to explain the different models and their pros and cons will be discussed (Chapter 3).

Finally, the different models will be discussed in relation to the policy framework in Afghanistan. Recommendations will be made regarding the most suitable models and key elements to be considered in future regulatory documents such as PPAs, and concession contracts will be proposed (Chapter 4).

2 POLICY AND REGULATORY FRAMEWORK FOR MINI-GRID DEVELOPMENT IN AFGHANISTAN

2.1 Private Sector Involvement

The importance of the private sector for energy sector development was already expressed in the in the Afghanistan National Development Strategy (2008) which mentions the following the following Energy Strategic Vision:

> *"An Energy sector that provides citizens of Afghanistan and drivers of growth in the economy with long-term reliable, affordable energy access based on **market-based private sector investment** and public sector oversight."(ANDS, 2008:31).*

According to ANDS, the private sector should also be encouraged to participate and invest in rural electrification. Based on ANDS a number of subsequent sector policies were developed. All of them reiterate the objective to strengthen the role of the private sector in developing the energy sector and rural electrification in particular.

Among all the different policy papers and strategies, the Afghanistan Rural Renewable Energy Policy (ARREP, 2015:15) is most explicit in proposing village mini-grids as a suitable means to electrify rural off-grid areas. The policy also outlines possible business models for O&M of mini-grids, the objective to involve private sector enterprises as well as financial incentives to raise their interest. The policy expresses also the commitment of the government to financially and technically (subsidies and technical assistance) support mini grid development (see Box 1).

2.2 Tariff policy

An important determinant for possible business models for village grids is the government's tariff policy. Shall villagers pay cost-covering tariffs, or shall there be a national uniform tariff, or shall there be subsidized tariffs for low-income tariffs, etc.? A specific tariff regulation has not yet been established but existing policies contain some basics criteria of a national tariff policy. The National Electricity Supply Program, for example, mentions (NESP, 2013:75):

> *"The Government's goal is to **raise tariffs** to cover 75% of DABS's costs, thus rising to at least 5.3 Afs/kWh (0.1 $/kWh) or 28%. However the proportionate increase in tariff will be different for domestic and commercial or industrial users. This will place a significant burden on households and represents a **political risk** for the Government, (…)."*

The above statement indicates that full cost-covering tariffs may not the ultimate goal of the government, in particular not for less well-off urban and rural households. The objective to avoid high tariffs is also expressed in the National Integrated Energy Policy (NEP 2016:14) which mentions to provide:

> *"Incentives to private sector to set up last mile distribution network in order to **avoid high tariffs for remote rural communities** since the cost of distribution network may be high in these areas."*

NEP further mentions that the challenge of affordability of energy cannot be ignored and proposes measures for poor population to include (NEP, 2016:16):

> *"Introducing **life-line tariffs for poor population and cross-subsidization** of these life-line tariffs would go a long way in making electricity affordable to poor communities."*

Box 1 Afghanistan Mini-grid Policy

Village mini-grids

Village mini-grids are able to serve tens or hundreds of households in settings where sufficient geographical density allows economical interconnections to a central power generator such as a small hydro, and contributing to an increase in rural industry and employment. The Government will facilitate the provision of credit, certificate or licensing procedures for private sector, power tariffs, and capital cost subsidies for projects that support the development of rural energy systems. Donors will be requested to assist with technical assistance for technology development and manufacturing within Afghanistan.

Business Models

Sustainable and replicable business models for both consumptive and productive uses of renewable energy in rural areas will be developed. In addition to existing solar home system business models, other models that promote long-term economic and social benefits will be adopted by building mini-grids around income-generating micro-enterprises incorporating renewable energy into water, agriculture, education and telecommunications. In all projects, the ability to demonstrate a viable business model, whether public or private, will be key to achieving project sustainability and replication.

Effective policy approaches for reaching the poorest may combine private sector involvement with targeted public subsidies linked to development objectives and strategies for increasing incomes. Long-term consumer credit to overcome high initial costs will be provided through dealer-facilitated credit and/or credit through, for example, microfinance organizations.

Private entrepreneurs in rural areas will be trained and financial assistance provided to establish **Rural Energy Service Centres** that will provide technical services related to the O&M of renewable energy systems at the local level.

Financing

In consideration of the high capital costs for many rural electrification options and the low cash capacity of rural households, innovative small-scale, affordable financing mechanisms will need to be developed, which may include micro-credit, leasing, prepaid meters and fees for service provision. The Government will investigate the potential for micro-credit financing of renewable energy projects.

Financial Incentives

The following financial incentives will apply to renewable energy power projects, and equally applicable to private, public-private, and public sector renewable energy power projects:

- No customs duty or sales tax shall be imposed for machinery equipment and spare parts meant for the initial installation or for balancing, modernization, maintenance, replacement, or expansion after commissioning of projects for power generation utilizing renewable energy resources.
- For the first 5 years of its commercial operation, the renewable energy developer shall be exempt from income tax arising from the profits derived from that operation.
- The Government may provide subsidies to communities to target the poorest segments of the population in rural areas.

(source: ARREP, 2015:15)

The Afghanistan National Renewable Energy Policy, among others, provides some guidelines for tariff setting for renewable energy projects (ANREP, 2016:11):

„1. For grid-connected projects- Tariffs for grid connected projects will be set on the 'cost-plus' basis. A firm PPA will be signed between MEW, DABS and Private utility and the project developer mentioning the tariff, including the escalations.

2. For project having distributed generation and local grid- for distributed generation projects supplying electricity to third party, tariffs will be decided on mutually negotiated basis between MEW/ utility, the project developer and the consumer. Guiding principle for *tariff determination could be 'cost- plus basis'. 'Avoided cost of generation' would be the basis in those regions where conventional generation would probably be significantly more expensive than REN source generation, as fuels have to be transported. A firm PPA will be signed between the project developer and MEW/utility.*

3. *For REN-diesel hybrid projects- Tariffs will be based on replacement cost of diesel and/or prevailing tariffs whichever is less.*
4. *For off-grid stand-alone project- Tariffs will be on mutually negotiated basis with an oversight provided by the Zonal Renewable Energy Center to ensure that vulnerable communities are not burdened with high and unaffordable tariffs for basic and essential electricity services."*

2.3 Project Financing

Similarly to the statements in Box 2, the other national policies also recognize the need of financially support the development or rural electrification projects through subsidies and financial incentives. NEP explicitly describes subsidies in Chapter 4.6 (NEP, 2016: 17):

"Costing of energy projects and the pricing of energy services thereof, are determined by a combination of pricing policies (i.e. subsidies) and taxation. Subsidies, though not desirable in the long run, may still be needed to make energy services affordable to poor. If applied, the subsidies in the form of ***capital upfront grant, tariff subsidies or interest subsidies*** *would be targeted to a specific sector or service and would be* ***linked to performance****. Examples are the* ***Generation Based Incentives*** *given to the project developer for every unit of electricity produced by wind farms to make them competitive as compared to fossil fuel based generation. Or* ***upfront grant*** *given to the utilities to extend the rural electricity distribution network to remote communities."*

2.4 Conclusions

From the above discussion of various national policies, it can be concluded that a supportive policy framework exists for broader private sector involvement also in off-grid electrification.

- Mini-grid development is seen as possible solution for off-grid electrification,
- The involvement of the private sector in O&M of isolated mini-grids is an objective of all policies,
- Subsidizing hardware and tariffs is deemed necessary to achieve electrification targets.

While the willingness is clearly expressed in the national policies, a concrete regulatory framework remains to be developed. The practical tools required for the implementation such as tariff regulations, standard concession contracts and PPAs are yet to be developed.

The present study aims to contribute to the development of such practical tools by identifying and classifying possible business models for O&M of isolated electricity supply systems. Case studies from other countries are presented to provide ideas for possible delivery models that can be replicated in adapted form for Afghanistan.

3 CASE STUDIES OF BUSINESS MODELS FOR O&M OF RURAL MINI GRIDS

3.1 Types of Business Models

The focus of this study is on off-grid mini-grids. To discuss private sector involvement in operation and maintenance, we have identified five delivery models with different ownership and operational characteristics. We do not distinguish between conventional or renewable energy sources. Key features are laid out in the table below.

Business Model	**Generation / Distribution/Retail**	**Relation to policies and regulations**	**Financial model elements**	**Reference case studies**
Fully public	MEW or MRRD builds generation part and hands over O&M to DABS	Afghanistan model thus far	-Public funds -National Tariffs -Cross-subsidies	Existing DABS operated mini-grids
Fully private	Ownership of assets and O&M by vertically integrated private firm or two or more private firms.	-In line with National Policies -Law requires license >100kW	-Private investment (partly subsidized) -Cost-reflective tariffs or subsidy	3.2 Concession Model in Mali 3.3 Captive Models
Mixed Model 1 **Or** **PPP Model**	MEW or MRRD builds and hands over to DABS but O&M outsourced to private sector either through **concession** or a fee-based **management contract**.	-Potentially in line with Policies	-No initial capital investment from Private Sector -Operating costs versus contractual fees	3.4 Mobile telecom towers in India
Mixed Model 2 or **PPA Model**	**Generation:** Private sector builds and owns the generation part and sells power under PPA to a local mini grid. **Distribution/retail:** DABS owns and operates the distribution and retail of electricity	-In line with policies -FiT for off-grid systems not yet available	-Private investment -Incentives through FiT/PPA	3.5 PPA Models
Community-based Model	Community / cooperative / municipal utility builds, owns and operates the mini-grid.	Model encouraged by policy, potentially easier licensing procedures	-Third party investment -Subsidies -cost covering tariffs	3.6 MHPs in Chitral 3.7 O&M services in Chitral, Pakistan

The discussion of business models and regulatory recommendations in this and the following sections are supported by the detailed, multi-country analysis in the recent World Bank publication *"From the Bottom Up: How Small Power Producers Can Deliver Electrification and Renewable Energy in Africa"* (Tenenbaum et. al., 2014), two recent publications by the Africa-EU Renewable Energy Cooperation Programme *„Overview of Framework to Attract Investment into Mini-Grids in the SADC Region"* (RECP, 2013) and *„Minigrid Policy Toolkit"* (RECP, 2014), as well as a recent study produced by Economic Consulting Associates and Partners *„Project Design Study on the Renewable Energy Development for Off-Grid Power Supply in Rural Regions of Kenya"* (ECA, 2014), complemented with the authors own experience with the setting up of private sector led models for O&M of mini grids (Meier, 2001/2012/2015).

Box 2 provides explanations of some general terms used in this study.

Box 2 About Concessions, Licences, Lease, and Management Agreements

The terms 'concession' and 'licence' (or license in US English) are often used synonymously. However, in terms of public infrastructure development, the term concession is more appropriate. **Concession agreements** are most often made between Governments (concessor) and the private sector (concessionaire) for the provision of public services such as electricity or water supply in a specific area over a certain period of time. The concessionaire usually develops infrastructure at its own expense, thus enabling new investment in public infrastructure and services without increasing public debt. The concessor allows the concessionaire to own and operate the concession assets for a specified period. During this period the concessor will try to recover the investment and generate a profit but is also exposed to a potential loss on its investment. For the use of public land and natural resources (e.g. water rights) the concessionaire usually has to pay the concessor a concession fee. At the end of the concession, the ownership of the assets is transferred back to the concessor, unless a new concession agreement is negotiated.

Other forms of contracts between public and private entities, namely **lease contract** and **management contract**), are closely related but differ from a concession in the rights of the operator and its remuneration. A lease gives a company the right to operate and maintain a public utility, but investment remains the responsibility of the public. Under a management contract the operator will collect the revenue only on behalf of the government and will in turn be paid an agreed fee.

A **licence**, in contrast, more often refers to a permit to execute more specific actions. For example a driving licence allows a holder to drive a car, or a company may acquire a licence to manufacture products which are patented by another company. Technicians may also obtain a licence for certain tasks such as maintaining airplanes or perform welding on pressure vessels. Another well-known secret agent even has a licence to kill.

3.2 Private Mini-Grid Concessions in Mali

Mali has adopted a concession model to rural electrification. In 2010, 82 concessions were in operation and 59,000 connections had been achieved, bringing the rural electrification rate to 14.9%, which exceeded the original targets. Most of the concessions in place operate diesel mini-grids but the government has started to actively support the use of renewables with funding from bi-lateral and multi-lateral donors and development banks.

One of the concessionaires, Yeelen Kura, currently operates 9 mini-grids located in the cotton-growing region in southern Mali since 2001 company. It is one of five companies supported by FRES (Foundation Rural Energy Services) of the Netherlands.

<u>Technical description</u>

Yeelen Kura owns and operates 9 solar hybrid mini-grids. Many of these sites started operations as diesel mini-grids which were later converted to hybrids. The total installed capacity of solar PV is of 622 kWp (capacity in each site ranges from 50kWp to 150kWp).

Yeelen Kura produces approximately 750 MWh of energy annually to cover the needs of approximately 5,000 mini-grid customers. Production is almost exclusively from solar PV with the diesel gensets being used as back-up.

The profile of energy consumers is 80% residential, 15% commercial and 5% public. Power consumption per user is low (12.5 kWh/month per customer) and mini-grids usually supply power in the afternoon and evening, making the integration of batteries (1 to 2 days of autonomy) fundamental.

Although minigrids should have the capacity of supplying energy on demand at whatever hour, technical limitations as well as requests arising from communities restrict operating hours in order to avoid high electricity bills for consumers. For example, the schedule in Kimparana is from 4pm to 1am.

Distribution is usually in low voltage and customers are equipped with meters or load limiters depending on the tariff scheme chosen.

The solar minigrid at Kimparana is 72 kWp was designed and installed by Dutch firm Tss4U. Technologies used include Ubbink modules, SMA grid inverters and sunny island systems and batteries.

The new solar PV plants at Kolondieba (50 kWp) and Ourikela (51 kWp) have been designed and installed by German system integrator Asantys Systems GmbH. They are also based on sunny island technology and have a hybrid configuration with diesel genset.

<u>Organization and Financing</u>

The approach to rural electrification in Mali is a concession model (concessions granted for 12 or 15 years depending on the installed capacity). These concessions are managed and regulated by AMADER (Malian Agency for Household Energy and Rural Electrification).

AMADER established a rural electrification fund (REF) which provides mini-grid operators with an 80% investment subsidy (with a ceiling of USD 500,000) to electrify concession zones. Funding for investment capital comes from the Government grants (the stated 80% investment subsidy) and other donor funds sourced through Dutch mother company FRES. The strategy of FRES is to help set up rural electrification concessions with a planned exit after the companies are deemed self-sustainable. Funders of mini-grid projects set performance targets based on number of connections.

<u>Tariff scheme</u>

Yeelen Kura is a vertically integrated energy supply company operating on a fee-for-service model. The tariffs are proposed by Yeelen Kura based on the costs of operation and balancing the clients' ability to pay. These tariffs require negotiation and approval by AMADER and are therefore not entirely cost-reflective. Currently, operating expenses and profits are covered by the fees charged to users but investment cost is not entirely recovered.

Tariffs are regulated by AMADER for each concession and take into consideration power generation costs. There are flat tariffs (for consumers with load limiters (50W or 100W) or tariffs for metered costumers (either for single phase or 3-phase supply). Average tariff for Yeelen Kura is approximately 0.50 $/kWh.

<u>Lessons learned</u>

A private concession model has allowed Mali to leverage limited public resources for rural electrification. Yeelen Kura has been an excellent example of technological innovation (first concessionaire to integrate renewables).

The main challenges faced by energy service companies and the AMADER are:

- Low energy consumption in rural populations. Electricity use remains at a basic level (lighting, basic appliances, etc.).
- Performance targets strongly linked to number of connections have generated ill incentives (one of the mini-grids decided not to connect large consumers such as a textile factory or a telecom tower) in favor of achieving more low energy consuming connections.
- The capacity of small local players to manage an energy company effectively with a fee-for-service model has been raised as a concern by AMADER.
- The income of the mini-grids currently do not allow initial expenses to be earned back, and expansion of the business continues to be dependent on government subsidy.

Figure 1 Handphone and Batterie Charging as a business

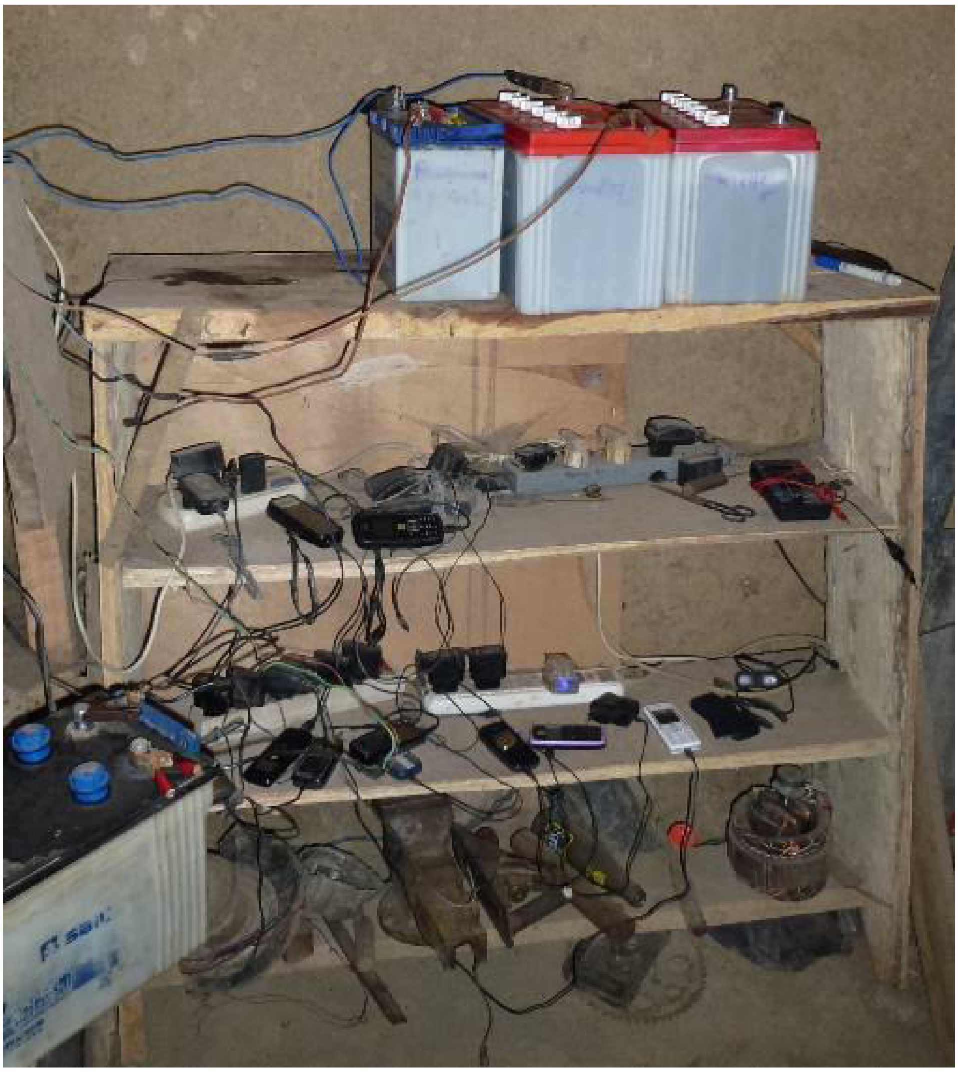


Photo: T. Meier, 2012, Rwanda

3.3 Captive Electricity Production Combined with Village Electrification

Business models based on captive electricity production address the first point in the aforementioned Lessons learned from Mali: Isolated rural electrification schemes often suffer from low load factors (the percentage of energy generated during a time period that can actually be sold). Where electricity is only used for evening lighting and operating a couple of TVs, the load factor can be as low as 25%. This means that a plant operator most likely does not generate enough revenues required to recover investment cost and also do proper plant maintenance. Such systems cannot be operated on a sustainable basis without relatively high cost covering tariffs and investment subsidies. Where villagers cannot afford such high tariffs there is a high risk that systems will sooner or later fall into disrepair.

<u>Possible solution</u>

Combining the generation of electricity by local small enterprises for productive purposes with village electrification in the evenings is an effective means to achieve higher load factors, in particular in the case of pico and micro hydro plants. Productive activities result in additional revenues from the sale of products manufactured. Depending on the type of business such revenues can be several times higher the mere selling of kWh to villagers. Part of the profits generated can be used to finance O&M of the power plants. Assuming that a small enterprise owns and operates such a pico-hydropower plant would mean that there is also a strong interest to make sure that the plant is well maintained to operate it on a sustainable basis and thus generate profits on a steady basis.

→ Entrepreneurs are needed that see MHP as a business opportunity

<u>Examples</u>

- In Central Africa, Pico and micro hydropower is frequently used to drive processing equipment, in particular mills and grinders for agricultural products. Adjacent villages are supplied with electricity mainly in from evening to the next morning.
- Ice Factories are energy intensive enterprises and are particularly indispensable for fishing communities in coastal areas. Selling ice to owner of fishing boats and local traders as well as transportation companies can be a highly profitable business.
- Tea factories in South and South-East Asia have traditionally operated captive power plants to operate their production equipment and have been selling surplus energy to neighboring villages connected via isolated mini grids.

<u>Risks</u>

The sustainable electricity supply to remote village communities through captive power generation by private companies largely depends on the economic success of these companies. It they are not able to operate their companies profitably then also the local electricity supply will collapse. It is therefore advisable not to link such systems to start-up companies but to existing manufacturing enterprises with a track record of successful business operations.

3.4 Mobile-Telephone Towers as Anchor Customers in India

This case study was selected as an example for Mixed Model 1. The hardware is owned by a government or a company but O&M is outsourced to the private sector (source: Omnigrid Micropower Company website www.omcpower.com):

It has been estimated that about 150,000 of India’s 400,000 mobile-telephone towers are located in off-grid areas or areas with an unreliable electricity supply from the grid. These off-grid towers mostly powered from small diesel generators owned and operated by a mobile-phone company or a tower company. The operation of such units is a headache for most operators because producing electricity at thousands of locations is not their core business.

Moreover, the cost of self-supplying electricity from a diesel generator is high. In India it has been estimated that about 40 percent of the operating expenses for a typical mobile tower are attributable to fuel and power costs. The comparable figure for Europe is about 12 percent.

An alternative business model has been developed by the Omnigrid Micropower Company (OMC) which is building small micropower installations in rural areas that use mobile-telephone towers as their anchor customers. At each site, OMC employs about 12–15 employees (about 10 of whom are local residents). At the end of 2012, 10 micropower installations were up and running in the Indian state of Uttar Pradesh. Under the OMC business model, the company sells electricity to the tower owner or operator under a deregulated long-term power contract (that is, a contract that does not require review or approval by the state electricity regulator). OMC produces the electricity from a hybrid generating system using some combination of sun, wind, and biogas with a backup diesel generator (usually acquired by purchasing the tower owner’s generator) and with some batteries to ensure a high degree of reliability. OMC’s plan is to locate each micropower installation so that it can sell electricity to three to five cellular-phone towers from each generating unit.

In August 2012 OMC signed a 10-year agreement with Bharti Infratel, one of India’s largest telecommunications service providers, to supply electricity to mobile-phone towers throughout the country. Bharti Infratel currently operates 33,000 towers, and 9,000 of them are off-grid. At each location, Bharti Infratel will be OMC’s principal but not only customer. OMC also provides electricity services to local villagers residing near the tower, using a prepaid “battery in a box” system. At the end of 2012 OMC was serving about 150,000 rural households and small businesses in Uttar Pradesh in addition to the mobile-telephone tower anchor customers. The novel feature of the OMC business model is that OMC does not build (at least initially) a traditional electricity distribution system with low-voltage lines and transformers to serve rural households and businesses. Instead, OMC provides electricity to its non-anchor customers from rechargeable lanterns and rechargeable battery boxes (sometimes called portable power sockets) owned by OMC and rented to its customers on a daily, weekly, or monthly basis. Once or twice a day local OMC employees deliver freshly charged battery boxes to customers. When the charged boxes are dropped off, the spent power boxes and lanterns are removed and recharged at the micro-generator site located next to the towers.

At these initial locations, a single entry-level lantern with a light-emitting diode (LED) lightbulb rents for about $2/month, a savings of approximately 50 percent compared to what the customer previously paid to provide lighting with a kerosene lantern. If the customer can afford to pay more, he or she can rent a box, two lanterns, and a fan for $7/month.

3.5 PPA Model: An Isolated SPP That Sells at Wholesale to a Utility

At first glance, the PPA Model seems strange: if a SPP is operating on an isolated mini-grid that is not connected to a national or regional grid, how can it be selling wholesale to a national or regional utility? But this situation exists in many emerging countries where, over time, many national utilities have been forced by political pressure to construct isolated mini-grids to serve communities that were not likely to be reached by the national utility's main grid for many years. In response to this pressure, the national utility built an isolated mini-grid served by a diesel generator because this required the smallest up-front capital investment. Once the mini-grid became operational, the national utility was usually forced to sell electricity to the customers on these isolated grids at the national retail tariff, even though its production costs at these locations were likely to be several times higher than this tariff. As renewable energy has become more economical, it is now common for SPPs to approach the national utility operating an expensive "legacy" mini-grid and offer to replace some or all of the national utility's diesel powered production with lower cost renewable electricity. This is especially interesting to the private sector, if the regulator sets a FIT at a level close to or equal to the national utility's relatively high, **avoided costs** on the isolated system.

In fact, this is already happening in Tanzania, where the feed-in price for SPP wholesale sales to the national utility's mini-grids is more than twice the price that the SPP would receive for wholesale sales to the national utility on the main grid.

Such a model may also be possible in locations in Afghanistan where DABS operates both small power plants as well as the local mini-grids. It may be interesting for DABS to outsource the generation part to specialized companies from the private sector, provided they could offer the O&M services at lower cost than currently incurred by DABS.

The private sector will not be able to carry the multitude of risks involved in rural electrification projects in Afghanistan, in particular the commercial risk and security risk. The PPA model would therefore be a solution for new village electrification projects in Afghanistan. The private sector investment in power generation infrastructure will provide leverage to the public funds. The construction and operation of the grid and retail sales by DABS relives them from the commercial risks of non-payment in rural areas. DABS as a large national organization may also be better equipped to deal with security issues as compared to a small private sector company.

The PPA model is further discussed in Chapter 4 which also includes program proposal for rural electrification in Afghanistan based on the PPA model.

3.6 Community Operated MHP in Pakistan

The community model is usually the model people have in their minds when talking about mini-grids in off-grid areas: A small generating plant (micro-hydro, PV, biomass, diesel, or hybrid) combined with a few kilometers of distribution lines and a village operator who acts both as producer and distributor of electricity, selling directly to final customers. This model has been applied in many developing countries throughout the world including Afghanistan. We discuss this model at the example of Chitral in Northern Pakistan:

Surrounded by some of the tallest mountains in the world, Chitral is Pakistan's northern-most land locked district, situated just across the border from Afghanistan. Land access beyond the valley is restricted to a few passes, all situated above 3,500m. The total population as per current estimates is about 500,000. Close to 90% of the population resides in 460 rural settlements, ranging in size from 20 to 3,600 inhabitants. Chitral town is the only urban settlement in the district, with a population of 20,600.

The district has been suffering from very limited access to basic services like education, health, road access and electricity. Until the late 1990s most of the population (approximately 94%) had relied heavily on fuel wood and kerosene for meeting their energy needs. This has caused in prolonging the vicious cycle of poverty in the valley with severe degradation of the environment particularly in the form of deforestation. To improve that situation, a number of NGOs supported by various donor agencies have started to develop Chitral's huge hydropower potential by developing MHP projects. The points below express the dynamics in MHP development:

- From 1990 to 2015, Aga Khan Rural Support Program (AKRSP) constructed 253 micro hydropower plants (MHP) with a total installed capacity of 23MW. Projects were financed by various international donors.
- Sarhad Rural Support Program (SRSP) is implementing the EU funded PEACE project which aims to develop 240 MHP in Northern Pakistan from 2012 to 2016.
- The Pakistani Government through its Pakhtunkhwa Energy Development Organization is planning to develop more than 300 MHPs in Northern Pakistan.

To support this process, a number of turbine manufacturers from the Islamabad area were trained in Indonesia for the production of crossflow turbines (by GFA-Entec/GIZ). These manufacturers have contributed significantly to develop the MHP sector. Today, it is estimated that 65% of households in Chitral receive electricity from MHPs. Thus, Chitral has now become a place having the highest concentration for community owned, built and operated MHPs all over the world. To reduce the pressure on wood resources in the areas, electricity is increasingly used for cooking and heating purposes. There is therefore a big demand for capacity upgrades at existing MHP sites.

<u>Community set up and Tariffs</u>

The donor projects in Chitral emphazised the idea of social mobilization for poverty reduction through community based participatory approaches. Village communities were facilitated to form into Village Organization (VOs) and Women Organization (WOs). Informal management committees were established at each MHP location and received basic training in O&M. VOs and WOs were later developed into formal Local Support Organizations (LSOs). These LSOs are the actual legal representatives of the communities. They have a higher level of accountability and are designated to take over O&M in the future.

In most cases tariffs have been set which are sufficient to cover operation cost and minor repair works, but do not recover investment cost. From a mini grid powered by a 100kW MHP, in average $200 to $250 are collected per month. The community's payment moral has been reported to be very good which may reflect the fact that electricity is much cheaper than Liquefied Petroleum Gas, kerosene, firewood and diesel. However, it was also reported that some MHPs have adopted a social tariff structure with very low electricity tariffs which do not allow generating sufficient revenues for MHP committees for proper O&M (GIZ, 2013).

<u>Problems faced</u>

Despite the social and poverty orientation of donor programs, the focus of MHP projects in Northern Pakistan has been the construction of the physical plants. In other words, the rest of the project cycle, from inception up to commissioning, as well as the subsequent operation phase, has been neglected to a certain extent. This has particularly severe consequences and finally leads to non-sustainable operation of MHPs.

In the case of Chitral, most MHPs built prior to 2009 are technically poorly designed, have no electronic load controllers (ELCs), are operated by barely trained personnel, and, as a consequence, are characterized by frequent down times and unreliable electricity supply. Systematic maintenance and repair services have not been available in Chitral. The concept of preventive maintenance is largely unknown and repairs are organized on an ad hoc basis. **Carrying out repairs usually takes weeks or even months in case whole turbine components need to be transported to the turbine manufacturers to Islamabad or if spare parts need to be ordered from distant places**. The situation is even worse during winter time when Chitral remains cut off from the rest of the country for 6 months due to snow cover of Lowari Pass.

The above findings could have been quantified in a recent study of the Pakistan MHP sector (GIZ, 2013). The study found that "…nearly three quarters of the plants examined showed weaknesses and faults, ranging from minor deficiencies, through severely reduced capacity, to total breakdown" (GIZ, 2013:10). These problems are not new findings but have been reported from various other countries already many years ago (Foley, 1992; Meier, 2001). A similar situation can be found in Northern Afghanistan where MRRD reported that an estimated 60% of MHP are in operational difficulties or out of operation.

3.7 Private Sector Operated Maintenance Networks

In response to the operational problems with off-grid power supply systems, a private sector company has established an innovative business model for the provision of sustainable maintenance and training services for micro hydro power plants in Northern Pakistan. The project is called Micro Hydro Resource and Service Center (MRSC) and is largely driven by an entrepreneurial initiative from the private sector. MRSC provides financially viable MHP training, maintenance, and repair services. The large market size in Chitral with hundreds of MHP being operated and hundreds more being planned are the precondition for an economic viable and sustainable system.

The objective of MRSC is not to put an end to community operation but to establish a service and training infrastructure which can be used by communities to fill the gaps required for sustainable O&M. MRSC specifically aims at improving the sustainable operation of MHP plants by providing economically sustainable maintenance and repair services. Therefore MRSC is managed in a business-like manner and provides its services on a commercial basis. Communities operating MHPs have to pay appropriate fees for training and service products. Services are priced competitively and provided in a professional way to be attractive for MHP communities.

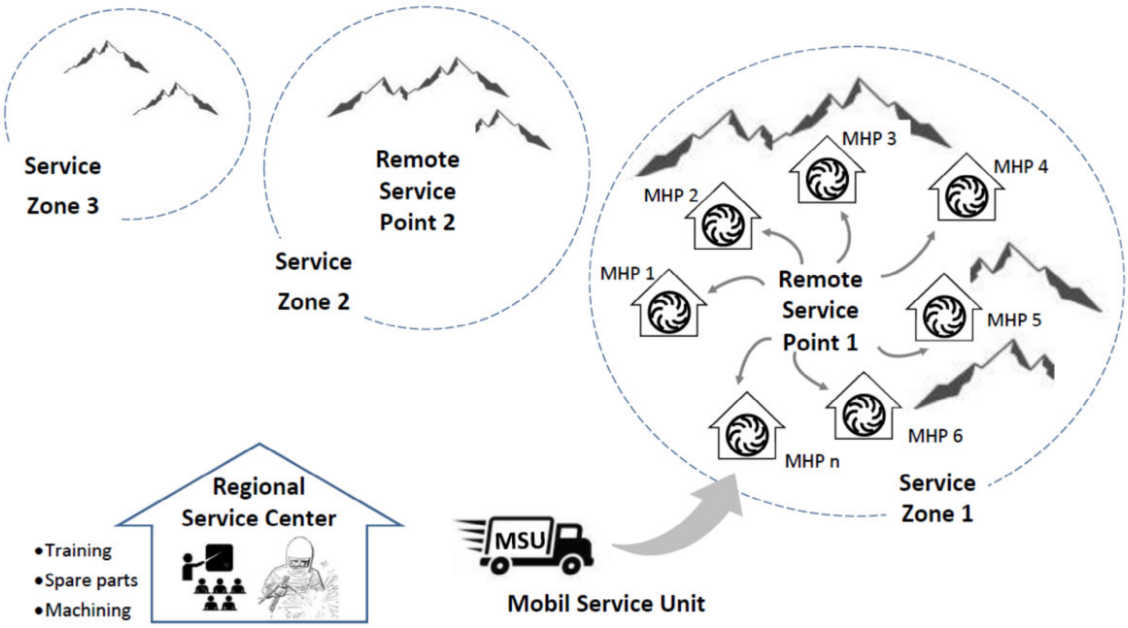
Currently, the routine wear and tear expenses of MHPs are being paid from the revenues collected. However, the non-availability of technical expertise as well as repair, maintenance and overhauling services make the operation and maintenance very expensive which negatively affects the sustainable operation of MHPs. MRSC is professionally staffed an provides its services to a large number of client community MHPs. It can therefore benefit from economies of scale and offer maintenance services at lower cost that if organized by the communities.

<u>Business Set up</u>

The MRSC located in Chitral town consists of a fully equipped workshop required for major repair and overhaul works of MHP equipment. The center also hosts training facilities for regular operator trainings and refresher courses. The key feature is the MHP service infrastructure which is maintained by well-trained service technicians. Additionally, a number of slightly lower qualified services technicians are located at remote service points to provide preventive maintenance and basic repair services in a defined service zone consisting of around 20 MHPs. The remote service point technicians are visiting their clients plants several times per year to inspect plant conditions and to do preventive maintenance. In case of technical problems they can be called by village-level operators to provide trouble shooting within a couple of hours. Therefore, they have a medium level of knowledge about MHP technology and to have basic mechanical and electrical skills. Remote service technicians are usually recruited from within their service zone and undergo training at MRSC in Chitral in all aspects relevant to their tasks in the field.

MRSC is also managing a stock of key spare parts to significantly reduce downtimes. For on-site repair works the MRSC is equipped with a mobile service unit to be called in from remote service points based on requirement.

Figure 2 Private Sector Operated MHP Service Network in Chitral Pakistan



(Source: own diagram)

Clients and Products

The main clients of MRSC are the village communities represented by LSOs. The spare parts shop is open to everyone and generates part of the revenues of MRSC. Also repair services and training services are open to everyone. Besides that, MRSC offers a service agreement package for MHP communities including preventive maintenance services from the remote service points (2 visits per annum), and complimentary participation in at least one training event per year. Different NGOs like AKRSP and SRSP and the private sector MHP developers will be valuable clients of the MRSC.

Replicability of MRSC concept

MRSC addressed the key problems related to rural infrastructure maintenance: village operators are trained on a regular basis to address staff fluctuations, fast response in case of technical problems beyond the capacity of village operators (less than 24h), availability of spare parts, and possibility to do major repair works locally. The concept is not technology specific and could be applied in virtually any rural infrastructure context. As mentioned earlier, a precondition is a sufficiently large market size because not every community can be expected to become a client. The case of MRSC in Chitral largely builds on a private sector initiative. Where such initiative is not available, the business model can also be established by the government and then outsourced to the private sector under a management contract.

Figure 3 Pictures of MRSC in Chitral, Pakistan

The pictures below show the location of the MHP Resource and Service Center in Chitral. The center is located on a compound of approx. 600m2.

The two-storey building in the front hosts the spare part shop on the ground floor and the training room on the second floor.

The shop offers key spare parts and off-the-shelf turbines and generators.

The machinery in the workshop at the time of installation in February 2015, the center was connected to grid, a pre-condition to operate workshop machinery.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Choice of business model

Based on the discussions in the previous Chapter, the main advantages and disadvantages of the different models can be summarized as follows:

Public model:	☹ highly reliant on cross-subsidies, 😐 no role for private sector, ☺ customers have low tariffs.
Private model	😐 less reliant on subsidies but ☹ at the expense of higher tariffs, ☹ high revenue risk (from negotiation of tariffs and non-payment) and high transaction costs, so there may be limited interest by private sector, 😐 Captive Model is more interesting but not yet widely applied.
PPP model	☹ possible conflicts over long-term regarding responsibility on re-investments, ☹ lack of precedents and model contracts.
PPA model	☺ clear division of responsibilities, ☹ requires recurrent subsidies, ☺ *but customers have low tariffs.*
Community model	☺ community buy-in, ☹ but serious concerns regarding technical and managerial capacity in remote rural areas. 😐 Therefore, set up of maintenance serivce network is crucial.

The assessment of the business models is not a purely technocratic matter which can be left to outsiders. The national policies as summarized in Chapter 3 have to be taken into account in particular in relation to energy access targets, involvement of the private sector, affordability of tariffs, and subsidy requirements. The different constraints and perspectives of government and the private sector need to be considered and weighed against each other when deciding which business model shall be selected and further specified in a regulation and promoted through specific programs.

The fully **public model** is certainly less interesting because there is virtually no role for the private sector except for the construction of the power plants and distribution grids. An ideal model would certainly be the **Private Model** because this maximizes the role of the private sector and involves the lowest level of subsidy. However, the key constraint is the national tariff policy because it carries an intrinsic political explosive force. As mentioned in Chapter 2.2, the Government's objective is to increase current tariffs to cover 75% of DABS's costs but **not** to achieve cost-covering tariffs. Therefore the rural population could likely feel treated unfair, if they would be expected to pay cost covering tariffs under a private model which will be much higher than tariffs in urban areas. In addition to that, it is known that DABS is struggling to increase its rate collection in grid-connected areas. There is quite a high risk that a private operator would also have to deal with high levels of non-payment in off-grid areas – this problem may grow even bigger, the higher the tariffs. The interest of the private sector to invest in fully private models may therefore be rather limited. A solution may therefore be the mixed models involving public and private stakeholders, the PPP model and the PPA model.

The **PPP Model** starts similar to the fully public model: MEW or MRRD plan and construct a mini grid project including the power plant(s). After commissioning the whole project is handed over to DABS. However, DABS is not operating the system itself but outsources the whole operation consisting of generation, distribution and retail to a private sector company. Outsourcing can be done based on a concession or management contract. The PPP model may be useful in case of privatization of the operation and maintenance of existing mini-grids. A private operator may work for less than DABS's cost, thus reducing the pressure on their budget. However, for the construction of new mini-grids this model appears to be less interesting since there is **no leverage of public subsidies** in the form of private investment.

The **PPA model** is more interesting since it can address a number of policy objectives as well as private sector needs. Under this model the private sector invests in power generation plants and sells the electricity under a PPA to the mini grid. The mini grid is developed by MEW or MRRD and will be handed over to DABS for operation. There is a clear division of roles and responsibilities. The PPA can define a feed-in tariff on a cost-covering level. DABS will be in charge for retailing the electricity under the national tariff structure. This will be appreciated by the rural population because they are treated like urban customers and can benefit from low electricity tariffs. The tariff structure can also include life line tariffs for very poor segments of the society. A negative element will be that the model will not only require investment subsidies but also **recurrent subsidies** to cover losses from not cost covering tariffs. However, the **PPA reduces the revenue risk** of the generation company which offers the possibility that at least part of the investment could be financed via a bank loan. We believe that the PPA model will be a suitable choice in a mini-grid powered by a power plant of at least 500 kW. The PPA model may also be suitable for larger island grids, however, the setting of the PPA tariff will have to be more competitive (through reverse auction, e.g.). In small off-grid projects the avoided cost tariff may be easiest method to apply.

The **Community Model** will continue to play an important role in Afghanistan in very remote areas, in particular where maximum loads are below 500 kW. To increase the sustainability of these Community Models it will be important to establish regional maintenance service networks similar to those described in Chapter 3.7. Furthermore, Community Models should be exempt from licensing requirements and tariff regulations. The recently published Law of Electrical Energy Services (IROA, 2015) requires licenses above 100 kW. We therefore suggest increasing this figure to 500 kW but introducing compulsory registration instead. MEW should be put in charge to monitor these mini-grids and be equipped with the right to take action in case of unwanted developments. However, regulation should be as light-handed as possible for such cases.

4.2 Results of Workshop on O&M business models

In cooperation with AREU, a two-day workshop was conducted in Kabul on Aug. 28 and 29, 2016 titled "Development of Business Models for O&M of RE off-grid power supply systems". 65 people have participated in the workshop from MEW, DABS, NGOs and the private sector, both from Kabul as well as from northern provinces. The classification scheme as developed in chapter 3.1 was introduced and thoroughly explained. Participants were the split into three working groups (1. governmental organizations, 2. donors and NGOs, 3. private sector). Their task was to discuss the advantages of different business models and select their preferred option for Afghanistan.

Both the governmental group and the private sector group selected the **PPA model** (mixed model 2) with public and private contributions as the preferred business model. In that model the mini-grid construction, operation and retailing of electricity remain in the hand of the public (MEW/MRRD/DABS) while the private sector invests in electricity generation plants and sells the power under a PPA to the mini-grid.

The governmental group preferred the PPA model because it provides some leverage of governmental funds but at the same time leaves them the overall control of operation and customer relationships. They believed that negative developments, e.g the exploitation of villagers by high tariffs, could be avoided with such a model. DABS representatives emphasized that working under PPA agreements is a standard procedure for them and therefore the preferred option.

In contrast to the other groups, the private sector group emphasized the various and significant investment risks in rural electricity supply. The PPA model was preferred since it eliminates the commercial risks related to retailing of electricity. However, it was underlined that there are other risks such as

- Permits Risk;
- Counterparty Risk;
- Financial Sector Risk;
- Political Risk;
- Security Risk, etc.

The scope of risks needs to be minimized in order to increase the attractiveness of investment in off-grid power supply (and power supply in general). In particular, it was demanded that the government should provide insurance for private sector investments and to handle security issues (regarding armed opposition groups).

A successful involvement of private sector in the energy sector will therefore very much depend to what extent such risks can be minimized in practice. The following chapter contains a proposal for a program to promote private sector investments in off-grid power supply and recommended elements to be considered in regulatory design.

4.3 Recommendation for the Setting up of the Afghanistan Rural Electrification Fund

Based on the theoretical discussions, case studies and workshop deliberations described in the previous chapters, the following **Program Proposal** for the **Afghanistan Rural Electrification Fund** (AREF) was developed.

The objective of AREF is to promote private sector investments in off-grid power supply projects in Afghanistan.

The Afghanistan mini-grid policy as described in Box 1 on page 4 strongly supports village mini-grids with private sector involvement in development and operation thereof. It is mentioned that "the Government will facilitate the provision of credit, certificate or licensing procedures for private sector, power tariffs, and capital cost subsidies."

AREF has been designed to provide capital cost subsidies, and to facilitate the provision of credit. AFEF is a multi-donor fund with a target size of USD 100. Part of the fund shall be used to provide equity grants to private sector investors and part of it of shall be used as guarantee fund to secure third party financing and to generally reduce the investment risks.

A technical assistance component shall provide capacity building and consultancy services to involved stakeholder. The technical assistance component is described in a separate capacity development plan.

Supported projects

AREF specifically supports off-grid electrification projects supplying rural customers through isolated mini-grids, preferably fed by power generated from renewable energy sources (hydro, solar, wind, and biomass).

Supported business models

In line with the results from the workshop described in the previous chapter, the preferred business model for the construction, operation and maintenance of the supported off-grid projects will be the PPA model (or Mixed Model 2) as further specified below:

Division of Responsibilities

- MEW/MRRD are responsible for project identification, per-feasibility studies, feasibility studies, tender design and tendering. They will be in charge to develop and maintain a pipeline of projects to be tendered.
- DABS will be responsible to construct the mini grid (MV and LV), to design the retail tariff system (according to the existing policy objectives), to do the service connections, to install the kWh meters, to check the security standard of household installations prior to connection, to do rate collection, to maintain the village grid, and to provide the required qualified staff for operation and maintenance of the grid.

  (DABS is free to outsource O&M, if there are interested parties with sufficient experience and qualifications.)
- Private sector companies will be in charge for the construction of power plants according to tender design and the generation of electricity and feeding the electricity into the mini-grid.

Power Purchasing Agreement

- DABS offers the private sector a power purchasing agreement (PPA) based on its **avoided cost of electricity production** at the referring locations (based on diesel generation cost).
- The PPA will guarantee a monthly minimum payment based on the expected electricity consumption as defined in the feasibility study and published in the tender documents.

  (The guarantee of monthly minimum payments is a steady source of income which can be used by the private sector to apply for third party financing.)
- The duration of the PPA will be 10 to 20 years, depending on technology. If reinvestments have to be done during that period, savings have to be accumulated accordingly. At the end of the PPA period, the assets will be transferred back to the Government of Afghanistan with compensation based on the non-depreciated value of the assets (BOT scheme).

The Bidding Process

- Competitive bidding will be applied to achieve the best value for money. Bidders will compete on the basis of smallest subsidy (grant by AREF) required for a given PPA tariff and specified minimum service levels. Minimum equity contribution is 20%, additional debt financing increases the winning chances of the applicant.

Risk Reduction Measures

- DABS assumes the risks related to non-payment of retail customers and manages security risks.
- MEW will ensure adequate insurance coverage of the assets and will compensate the private investor in case of damages or loss of assets caused through acts of war which cannot be insured (part of AREF shall be reserved for such purposes).
- The successful bidder will immediately be given a generation license upon signing of the contract without any further administrative steps.
- Available investment guarantees by other governmental agencies, will be mentioned and explained in the bidding documents.
- Up to 10% of AREF Funds can be used to provide partial credit guarantees.

The above concept of the AREF investment promotion program still needs to be approved by MEW. After approval, the program can be further elaborated in detail under the technical assistance component.

5 REFERENCES

ANDS (2008): Afghanistan National Development Strategy. Energy 1387 -1391 (2007/08-2012/13) Volume II, Pillar III, Infrastructure.

ANREP (2015): Afghanistan National Renewable Energy Policy. Ministry of Energy and Water (MEW). Final Draft: January 2015.

ARREP (2013): Afghanistan Rural Renewable Energy Policy. Ministry of Energy and Water (MEW), Ministry of Rural Rehabilitation and Development (MRRD). Final Draft April 2013.

ECA (2014): Project Design Study on the Renewable Energy Development for Off-Grid Power Supply in Rural Regions of Kenya. Final Report, November 2014 submitted to KfW by Economic Consulting Associates (UK), Trama Tecno Ambiental (Spain), Access Energy (Kenya).

Foley, Gerald (1992): Renewable energy in third world development assistance. Learning from experience. In: Energy policy, Vol. 20, No.4, pp. 355–364.

GIZ (2013): Strategy for Improved Quality and Management of Community Based Mini-Micro Hydro Power Plants (MHP) in Pakistan. Published by GIZ Renewable Energy and Energy Efficiency Project (REEE) Pakistan, September 2013.

IROA (2013): Power Sector Master Plan, Islamic Republic of Afghanistan. ADB Technical Assistance Consultant's Report, Project Number: 43497, May 2013

IROA (2015): Legislative Decree of the President of Islamic Republic of Afghanistan About Endorsement of the Regulating Law of Electrical Energy Services. No: 67, Date: 30/08/2015, official English translation.

Meier, T. (2001): Mini Hydropower for Rural Development: A New Market-Oriented Approach to Maximize Electrification Benefits. With Special Focus on Indonesia. Culture, Society, Envi-ronment – South Asian and South East Asian Studies, Vol. 4, Lit-Verlag, Münster.

Meier, T. (2012): Policy Recommendations to Improve the Sustainability of Rural Water Supply Systems. Based on the Experience with Conventional and Photovoltaic Pumping Systems. IEA PVPS Program, Photovolatic Services for Developing Countries.

Meier, T. (2015): Innovative Business Models and Financing Mechanisms for PV Deployment in Emerging Regions. IEA PVPS Program, Photovolatic Services for Developing Countries.

NEP (2016): Aghanistan National Energy Policy. Ministry of Energy and Water. Final Draft February 2016.

NESP (2013): National Energy Supply Program. Infrastructure Development Cluster. Government of the Islamic Republic of Afghanistan, Final Version January 2013.

RECP (2013): Overview of Framework to Attract Investment into Mini-Grids in the SADC Region. Supportive framework conditions for mini-grids employing renewable and hybrid generation. Study elaborated on behalf of the Regional Electricity Regulators' Association of Southern Africa (RERA), financed under the Africa-EU Renewable Energy Cooperation Programme (RECP).

RECP (2014): Minigrid Policy Toolkit. Policy and Business Frameworks for successful Mini-grid Roll-outs. Africa-EU Renewable Energy Cooperation Programme (RECP).

Tenenbaum, Bernard, Chris Greacen, Tilak Siyambalapitiya, and James Knuckles (2014): From the Bottom Up: How Small Power Producers and Mini-Grids Can Deliver Electrification and Renewable Energy in Africa. Directions in Development. Washington, DC: World Bank.

Picture on Titelpage from OMC India: www.omcpower.com

6 ABBREVIATIONS

AMADER	Malian Agency for Household Energy and Rural Electrification
AKRSP	Aga Khan Rural Support Program
ANDS	Afghanistan National Development Strategy
ARREP	Afghanistan Rural Renewable Energy Policy
ANREP	Afghanistan National Renewable Energy Policy
AREF	Afghanistan Rural Electrification Fund
DABS	Da Afghanistan Breshna Sherkat
EU	European Union
FiT	Feed-in-Tariff
FRES	Foundation Rural Energy Services
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH
IDEA	Institutional Development for Energy in Afghanistan
IPP	Independent Power Producer
IROA	Islamic Republic of Afghanistan
kWh	Kilowatt-hour
kWp	Kilowatt peak
MEW	Ministry of Energy and Water
MHP	Micro Hydro Power
PV	Photovoltaic
MWh	Megawatt-hour
MW	Megawatt
MRRD	Ministry of Rural Rehabilitation and Development
NGO	Non-Governmental Organizations
NEP	National Integrated Energy Policy
NESP	National Electricity Supply Program
NSP	National Solidarity Program
O&M	Operation and Maintenance
OMC	Omnigrid Micropower Company
PPA	Power Purchasing Agreement
REN	Renewable Energy
REF	Rural Electrification Fund
SPP	Small Power Producer
SRSP	Sarhad Rural Support Program
LED	Light-Emitting Diode
SADC	Southern Africa Development Cooperation
VO	Village Organization
WO	Women Organization
LSO	Local Support Organizations

ELC	Electronic Load Controllers
MRSC	Micro Hydro Resource and Service Center
PPP	Public Private Partnership
BOT	Build Operate Transfer