REToolKit Case Study

Argentina PERMER: The Argentine Off-grid Electrification Concessionaire EJSEDSA.

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1. The Project

Offgrid Electrification. A new generation of World Bank power projects aims at developing markets for innovative "offgrid" electrification technologies that can provide basic electricity services to remote rural areas at lower costs and higher access growth rates than traditional rural electrification approaches, by matching the low local demand in a more sustainable and flexible way. The inherently decentralized character of these offgrid technologies causes a set of paradigm shifts in service delivery models as compared to traditional power projects. The term "offgrid system" includes village minigrids, based on diesel or diesel-hybrid systems with Renewable Energy generation (e.g. micro-hydro or wind); and stand alone diesel generators or Solar Home Systems (SHS). SHS are a promising solution for all dispersed users: They typically include a photovoltaic (PV) module, a battery, a charge controller, wiring, fluorescent DC lights, and outlets for other DC appliances. A standard Solar Home System can operate several lights, a black-and-white television, a radio or cassette player, and a small fan. SHS can eliminate or reduce the need for candles, kerosene, liquid propane gas, and/or battery charging, and provide increased convenience and safety, improved indoor air quality, and a higher quality of light than kerosene lamps for reading. The size of the system (typically 20 to 100 Wp) and the local insolation determine the number of "light-hours" or "TV-hours" available. For example, a 40-50Wp SHS usually provides enough power for four hours of lighting from four 7W lamps each evening, as well as radio, cell phone charging and a few hours of b/w television. SHS initial costs range from US$250 to US$1,000, depending on system size and stage of local market. There are more than 1,000,000 SHS installed today in rural areas of developing countries (including solar lanterns, which are very small SHS).

PERMER Project. Argentina has made significant progress in its efforts to reform the power sector. While it has a relatively high overall rate of electrification (over 95%), substantial numbers of the rural population still remain without electricity services (over 25%). The Renewable Energy for Rural Markets Project (PERMER), financed by World Bank and GEF, aims at providing about 35,000 remote rural households, 1,750 public services (rural schools, health posts) and 500 productive uses with electricity through provincial "offgrid concessions" that are negotiated or bid out for minimum subsidy and regulated by independent provincial regulating agencies. The concessionaire is free to choose the least cost technologies applied to meet his universal service obligation. Initial investment costs are divided up between the user (about 10% of investment costs paid up front as connection fee), the concessionaire (i.e. 30-40%, depending on service level) and an upfront subsidy. This project subsidy is about 50-60% and paid partly at the time of procurement of a new lot of systems and partly against met installation targets, to balance the advantage of a direct control of outputs with manageable working capital costs to the concessionaire. Installations, service quality and customer satisfaction are verified ex post by the regulator. The monthly user fees pay for O&M costs (typically about 50% of lifecycle costs) and for recovering the concessionaire's share of investment costs. In some cases, provincial subsidies are applied to further lower the monthly user fees out of social considerations (e.g. 'Ley de Puna' in Jujuy), based on customers' ability and willingness to pay.

Jujuy. The most advanced PERMER concessionaire, EJSEDSA (*Empresa Jujeña de Sistemas Energéticos Dispersos SA*) in the province of Jujuy, is operating since December 1996 and was delivering sustainable electricity service to about 4,000 rural households and schools by 2002 (up from about 1,500 users in 1997), by means of minigrids for agglomerated households (powered by micro-hydro, diesel or PV-wind-diesel-hybrid systems) and Solar Home Systems for dispersed households, against monthly user fees reflecting the service levels. Ownership of the SHS module, charge controller and battery in this fee-for-service approach lies with EJSEDSA; internal installation is paid for and owned by the user or by local government (payment in rates is possible). This allows for repossession of SHS in case of default on user fee (following a previous notice). Reconnection costs

are set at triple the initial installation fee. About 40 SHS have been de-installed over the last five years because of payment default.

Demand Focus and Choice. To assure that energy services meet the local demand, as well as to attract private sector interest, market studies have been conducted for all interested provinces. The existence of such a market study is one of three preconditions for becoming a PERMER participating province that is entitled to subsidies from the Bank loan. Ten provinces counted with a market study by 2002. In the case of Jujuy, the initial average ability to pay for basic electricity services had been estimated at around $10 to 15 (based on current substitutable energy expenditures as estimate for minimum WTP). The demand study has been used by EJSEDSA to determine their product mix. Each user can choose (and in minigrids - change) his service level individually. Up to now, EJSEDSA has decided to install 100Wp SHS as standard for all isolated users, mainly for standardization and economies of scale (bulk purchase). In the new concessions planned under PERMER, a broader range of SHS sizes will be offered.

2. The Supplier

The business model is changing 'from grid to offgrid'. The management and technical personal of EJSEDSA stem from a spin-off from EJESA, the concessionaire of Jujuy's grid-connected market. This was reflected in EJSEDSA's original business plan and service philosophy which copied the traditional grid connected business. Since then, various lessons have been learned and EJSEDSA's way of doing business has changed. Most of these changes are aimed at lowering the extremely high costs of operating and maintaining the very remote and dispersed systems in Jujuy's vast and mountainous "Puna" zone. One common underlying element to most of these changes is an increased attention participation of users and local microenterprises:

Local subcontractors are a promising solution to improve concession models. For operation and maintenance services (daily operation for the minigrid systems; annual visits, reaction on system failure and fee collection for the SHS systems) EJSEDSA is relying on a combination of five technicians in the provincial headquarters, 42 local minigrid operators (some of which also service isolated SHS that are close by), plus about 20 additional local 'subcontractors' – microenterprises servicing isolated SHS in remote areas for EJSEDSA. The original business model was improved significantly by adding the SHS subcontractor level: The subcontractors are responsible for fee collection, new installations, and most maintenance services in their own 'service areas' - comprising 12 to 300 SHS in areas of up to 100 km diameter. In addition, subcontractors sell spare parts for EJSEDSA's SHS and some of them repair and sell DC appliances on their own account (typically charging 10 to 20 Pesos per repair, especially for fluorescent DC lamps). They are paid by both the concessionaire (base salary of 300 to 500 Pesos per month for the minigrid operators; performance fee of about one Peso per monthly SHS fee collected) and the users (against additional goods or services received). Reasons for failure in the SHS operated by EJSEDSA have included (in order of frequency): defect fuses, missing battery water, discharged batteries, disconnection, non-permitted appliances, and few physical defects. The monthly income of a SHS subcontractor out of this occupation can range from 15 to 350 Pesos per month, depending on range of services and service area. This new business model combines a variety of important advantages, most of them related to increased demand focus:

(i) EJSEDSA saves significantly on O&M costs as they can replace costly field visits (personnel and transportation) by visits of the subcontractor who receives a lower salary and travels less costly (being closer to start with).

(ii) The subcontractors are closer to the market, both in geographic and social terms, and can hence react directly and in a more flexible way to individual customer needs.

(iii) The majority of users in Jujuy's Puna are indigenous – and so are the subcontractors. This improves communication.

(iv) Being present locally, the subcontractor has a better grip on potential reasons for payment default, is less likely to schedule visits when users are not present (a typical problem in migration-prone Jujuy) and can enforce payment partly through social pressure. Payment default rates have gone down slightly since local subcontractors are being used (about 20%).

(v) This local social control works both ways: In recent interviews, one of the subcontractors has explained clearly that he feels responsible towards 'his users' for the <u>overall</u> service quality.

(vi) Some of the users are paying the subcontractor with goods (for which EJSEDSA in the provincial capital would have less use) instead of money, which reduces default rates and increases local market efficiency.
(vii) Additional high value employment and income is created in local micro-enterprises.
(viii) One of the subcontractors has started to offer a variety of additional services, responding to local demand, e.g. he is repairing broken TV sets and radios and rewiring appliances from AC to DC.

3. The User

The user is the central part of any offgrid system – therefore borders blur between user and utility. One of the most interesting findings of a recent study on the emerging issues of service quality in Jujuy is that both the perception of responsibilities and the specific O&M arrangements for the individual offgrid systems have evolved over time, depending on the specific users and technicians. This tendency was particularly striking for the Solar Home Systems (SHS). In theory, EJSEDSA had defined the switchboard as the border of responsibility for all SHS – generation (including the battery) belongs to EJSEDSA, while appliances and internal installation were supposed to be the user's. In some cases this separation has worked, but in many others it has created confusion and de facto been altered: the borders between user and utility have started to blur. While this change in roles and the insecurity due to poorly defined responsibilities have led to decreased user satisfaction (and system misuses) in some cases, these findings show a way to further service improvement and cost reduction in isolated systems: Depending on the user's (or his neighbor's) willingness and ability to take over certain parts of operation and maintenance (e.g. - in order of difficulty - cleaning the modules, checking and refilling water in the batteries, replacing the fuse, repairing simple parts), the monthly fee could be reduced. The more responsibility a user takes (if this is done explicitly), the lower are not only the O&M cots, but the higher are system lifetime, "ownership" - and ultimately satisfaction. Battery ownership has the most direct influence on user behavior and lifecycle costs. Therefore, fee-for-service models run a high risk if batteries are not owned by the user. For very small systems (e.g. 20 Wp) with user-owned batteries, it has even been argued that the charge controller could be replaced by a simple indicator, assuming that rural users are used to economize on scarce resources that are dependent on seasons and weather (e.g. water).

Training is crucial. A full time sociologist has been hired by EJSEDSA in 2000 to improve user training and demonstration material for SHS. This is aimed at (i) improving battery treatment so as to decrease lifecycle cost and increase user satisfaction (less failures), (ii) avoid misuse of components (e.g. short-cutting fuses and charge controllers, use of inadequate loads) so as to reduce system failures (and the related costly repair visits!), (iii) improve the users' understanding of their systems and energy efficiency measures (i.e. to increase 'energy culture') and the roles and responsibilities of each player so as to improve overall user satisfaction, and (iv) ultimately lower the default rates. A training session is given to each user during system installation.

4. The Regulator

Regarding the provincial regulator, two important ways for cost reduction have been identified:

Adopt adequate 'offgrid service standards'. Specific regulations for rural service have to be adopted to allow for the different service level provided by offgrid systems. Jujuy's original service quality requirements for the offgrid area were oriented too closely at urban (grid) service quality. As an example, initial response times of 24 hours were unrealistic and would increase any offgrid utility's costs (and hence the tariff) unnecessarily, as the majority of rural user's needs do not require 24/7 service all year long (an exception is e.g. refrigeration of vaccines in rural clinics). Meanwhile, response times in Jujuy have been increased to a more adequate level (five work days for SHS reachable by car; and nine work days for systems reachable by foot or donkey only). Service quality and tariffs are adapted every two years, with the next proposal to be submitted by EJSEDSA in January 2003. Users can complain directly at one of EJSEDSA's offices, through the local technicians, via phone or via public radio. The technical definition of minimum service quality had also been copied from the grid initially, but has now been adapted to minigrid conditions (less than 12 failures and less than 25 total hours black out time per semester – as measured by data loggers). Tools like the 'SHS tester', and pre-paid meters have been considered by the regulator and EJSEDSA as a solution

for simplified regulation of both SHS and minigrids. All minigrids systems (mini-hydro, diesel or PV) currently have simple integrating meters for user fees.

Reduce Transaction Costs. The Jujuy regulator (*SuSePu*) faces similar challenges as EJSEDSA regarding the high cost of visiting the remote areas. Again, users may be part of the solution: already now, local community organization representatives (soccer club etc.) are reported to play an important role in facilitating the communication between dispersed users and the regulator. A system involving such community organizations in the monitoring and evaluation of service quality and access targets may prove to be both less costly and more successful than traditional approaches. Where available, basic ICT tools (e.g. phones, radio) facilitate efficient complaints management and participatory M&E.

5. Conclusions and Outlook

The driving force behind all of EJSEDSA's improvements to their business model is the aim to decrease the high costs of visiting remote, decentralized systems: In any remote offgrid system, the user is by definition the only one who is always at hand. User behavior therefore decides about the ultimate quality of service – and interventions from utility side should be avoided where possible.
The most interesting improvement EJSEDSA has made to its business model since 1996 is the integration of independent local microenterprises as 'subcontractors' in the downstream part of the rural service delivery chain. These extension agents have the potential to reduce the high transaction costs in remote areas, and to increase demand focus, user satisfaction and payment rates. They also create local employment. Such local microenterprises could take over local O&M tasks for more than one service: where 'fully bundled provision' by one rural multi-utility may often be difficult to achieve (because of existing differences in regulatory frameworks, financing, access targets and schedules), leveraging costs on this decentralized level is easier to achieve - and has in fact occurred spontaneously in Jujuy in at least one case (local minigrid operator also collects fees for satellite TV). Similar models could be a valuable improvement to new decentralized business models for service provision to remote rural areas.
PERMER implementation has slowed down significantly due to Argentina's current economic crisis. In specific, EJSEDSA is facing a variety of new problems: Theft of SHS has started in 2002 and amounts to 30 stolen SHS by now; some of the spare parts have to be imported and suffer from devaluation (e.g. charge controllers have quadrupled in local price); spare parts are available only against pre-paid bills; and demand for additional services (e.g. AC productive applications) has stalled. However, during such a crisis mini-hydro village minigrids and the SHS systems proof to be easier to sustain than diesel minigrids, as O&M costs for the latter are directly related to fuel prices. Despite the crisis, the concessionaire is continuing with the installation of SHS: 750 new systems were purchased in early 2003 and are now being installed.