

# Regulatory Approaches to Rural Electrification and Renewable Energy: Case Studies from Six Developing Countries

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**Summary.** -- This paper describes regulatory approaches to stimulating provision of electricity services among rural off-grid populations in developing countries using conventional and renewable energy sources. Six case studies draw upon the emerging experience from several countries and projects by the World Bank, UN Development Program, and Global Environment Facility. Cases describe concession and institutional arrangements, subsidies, and service standards and monitoring. The concession approach for rural off-grid electrification is relatively recent in rural development practice. Very few implementation lessons are yet available. Still, early experience can serve as a guide to regulators, firms, and development institutions seeking to promote rural off-grid electrification.

*Keywords:* Latin America, Africa, energy, solar power, rural development, private enterprise

## 1. INTRODUCTION

Two billion people in developing countries still lack access to modern energy services, according to the World Bank (1996). Some of these people will be served by grid connections during the next decade. But large numbers will remain unconnected because of the high costs of grid extensions in rural areas. Rural off-grid electrification can provide an alternative solution at lower cost, particularly as costs of off-grid technologies decline. And for off-grid applications, renewable energy technologies can reduce environmental impacts and provide lower-cost alternatives than conventional energy technologies (Foley, 1995; Cabraal et al 1996 and 1998; ESMAP 2000a and 2000b; Kaufman 2000).

How to deliver electricity services to rural populations sustainably? Many examples exist of both public programs and private-sector-led markets for off-grid electrification. Experience in a number of countries, particularly China, India, Kenya, Mexico, Senegal, and Sri Lanka, has been documented. For example, in India there has been a long-standing program of financial incentives for solar photovoltaics, which has resulted in 50,000 solar home systems and 30,000 solar street lights. In Mexico by early 1996, over 24,000 solar home systems had been installed

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under a government program, along with nearly 10,000 PV-based telephones. In Kenya, over 100,000 solar home systems have been installed by the private sector without much public assistance (Barnett 1990; GTZ 1996; Sokona 1997; Taylor 1997; van der Plas and Hankins 1998; Piscitello and Bogach 1998; Kammen 1999; Martinot et al 2000).

Many public programs have relied on equipment donated through bilateral development assistance programs; only some have included sustainable mechanisms for servicing installations or continued commercial viability. Only a few programs employ public or private “fee-for-service” electricity providers that some consider conducive to sustainability. Noteworthy cases include a public energy-service company on the outer islands of Kiribati, a public-private energy-service company in the Comoros Islands, and a purely private-sector effort in the Dominican Republic (Hansen 1998; Gillet and Wilkins 1999; van der Plas 2000). But these models have been limited in geographic scope and have not been designed to provide universal coverage to rural populations.

In recent years there has been growing interest in the use of regulated “energy-service concessions” and other public-private regulatory mechanisms as a way to provide affordable and universal electricity services to rural populations not connected to central electric power grids. Rural energy-service concessions may employ a mixture of energy sources to serve customers, including diesel generators, mini-hydro, photovoltaic, wind, and biomass. Installations may be household-scale systems (i.e., photovoltaic “solar home systems”) or village-scale “mini-grids” using a hybrid mixture of solar, wind, hydro, diesel, and battery storage (Reiche et al. 2000; Kaufman 2000).

This paper describes six case studies of regulatory approaches for promoting rural off-grid electrification. Most of the cases are World Bank or UNDP projects with support from the Global Environment Facility (GEF) that are just getting underway (see Martinot and McDoom 2000 for details on the GEF). Unfortunately, there is very little implementation experience from these projects to date; most approaches described are based on project designs and expected results rather than accumulated practical experience. Still, project designs and early experience point to significant emerging issues and highlight a range of potential approaches. This synthesis can serve as a guide to regulators, firms, and development institutions seeking to promote rural off-grid electrification. Sources of information come from published material, unpublished sources, and interviews with project managers and observers.

## **2. SIX CASE STUDIES**

Below we review six case studies of emerging rural energy-service concessions in Argentina, Benin, Bolivia, Cape Verde, Peru, and Togo.

### ***(a) Argentina PAEPRA Program***

As part of Argentina’s on-going efforts to reform and privatize the power sector, the Argentine government began to address off-grid electricity services in 1995 with its “PAEPRA” program (Programa de Abastecimiento Electrico de la Poblacion Rural Dispersa de Argentina) (World

Bank 1999a; IDB 1999). The government divided provincial electricity service into two distinct markets: (i) concentrated (primarily urban), grid-connected customers; and (ii) dispersed (primarily rural) off-grid customers. The PAEPRA program aims to supply electricity to 1.4 million rural residents (about 300,000 households) and more than 6,000 public facilities (e.g., schools and hospitals) through private rural energy-service concessions. The World Bank (1999a) said that “this public/private partnership for the provision of electricity service to remote, low-income areas is unique in the world and considered internationally as a highly innovative approach to the problem” (p.7).

Under PAEPRA, the provincial government sets tariffs for particular types of electricity services. A competitive tender is held, under which companies bid for a 15-year monopoly concession contract. Under the contract, the concessionaire is obligated to service all households and public facilities within the province at tariffs set by the provincial government (although concessionaires have the right to discontinue service if customers do not pay in a timely manner). Concessions receive subsidies from the provincial government; companies compete for this contract partly on the basis on how little subsidy they are willing to accept.

Argentina already had substantial experience with rural concessions in other areas like water and telecommunications. Compared to alternate approaches, such as a competitive market with private dealers, the potential advantages of the concession approach were seen to be:

- creates a market of sufficient “critical mass” for commercially sustainable business by granting exclusive rights over a large geographic area;
- attracts larger, better organized private companies with their own sources of financing;
- permits easier administration and regulation;
- brings better chances of covering a large number of customers in a few years;
- involves good potential for reducing unit costs of equipment (through volume discounts), transactions, operation and maintenance (through economies of scale) and reduced per-unit overhead costs; and
- ensures service to the consumer over a long period (i.e., 15-year contract life of the concession).

Concession contracts have so far been bid and awarded in two provinces: Jujuy and Salta. In Jujuy, the urban and rural concession contracts were awarded to EJSEDA, a company owned [or majority-owned] by Compania General de Electricidad (CGE) of Chile. In December 1996, EJSEDA began operation and inherited about 1,200 household customers and 70 public facilities in rural areas. From December 1996 to December 1998, EJSEDA provided electric service to approximately 600 additional rural households. Concession contracts are set to be awarded in La Rioja and Corrientes. La Rioja will be a bundled-service contract including water services.

### ***(b) Argentina Renewable Energy in the Rural Market Project***

In 1997 the Argentine government requested financial assistance from the World Bank and Global Environment Facility (GEF) to implement its PAEPRA program in several provinces. The World Bank/GEF “Renewable Energy in the Rural Market” project aims to supply electricity to 66,000 households with individual solar home systems (of size 50Wp to 400Wp),

1,100 public facilities with solar photovoltaic systems, and 3,500 households with village-power systems (using mini-hydro or hybrids such as solar/wind, wind/diesel or solar/diesel) (World Bank 1999a). Concessions are free to select which technology to apply in any given situation, including diesel-only village power systems (however, GEF grants only apply to solar home systems installations).

The concessions will provide and maintain solar home systems for households and public facilities and collect monthly fees-for-service. Concessions will be obligated to:

- provide electricity services to rural off-grid customers anywhere in the province for a period of at least 15 years, upon request;
- carry out all necessary maintenance, repairs or replacement of components as needed to ensure the continuity of the electricity service to each and every customer;
- provide “state-of-the-art commercial service standards” for connection requests, billing, collection and claim handling; and
- provide the provincial utility regulatory agency (ENRESP) with periodic reports on the status of the concession including but not limited to performance indicators such as number of connections by type of consumer and method and technology supply, outages statistics, and financial results.

Concessions are eligible to re-bid for their business every 15 years up to a total of 45 years, competitively against other eligible firms. The 15-year period was seen as a compromise between the need for a short period for the quasi-monopoly and a long period for the annuity calculations of the concession (and hence the need for subsidies). After 15 years, the government can modify the concession rules to account for new technological developments, or may even decide to abandon the concession system and open the market to competition.

Eight provincial governments (out of 22 total) are eligible to participate in the project by signing agreements with the central government and World Bank. Each of these provinces has privatized or is in the process of privatizing its power sector, or at least has made a legal commitment to privatize. Four of these provinces have existing private concessions serving the concentrated (urban) market that are regulated by the provincial governments. Under the project, these governments will first try to negotiate a rural concession contract with their existing concessions (as an amendment to the existing contract). If such negotiation fails, or if there is no existing concession for that province, then a new concession contract will be awarded according to international competitive bidding procedures. In one province, La Rioja, the government is about to tender a combined water and rural energy concession.

### ***(c) Benin and Togo Decentralized Rural Energy Projects***

Two World Bank/GEF “Decentralized Rural Energy” projects under development with Benin and Togo also use a monopoly concession model (GEF 1998a and 1998b). The two projects are quite similar to each other. Each project will establish at least two financially viable private-sector installation and service companies. Like Argentina, monopoly concessions will be granted to these companies for 15 years to the winners of a competitive selection process. Each

concession will have exclusive rights to service a specific geographical region. Like Argentina, concessions will be responsible for installing and maintaining systems and collecting fees from customers. And also like Argentina, concessions are eligible to re-bid every 15 years to renew their contract, up to a maximum of 40 years. Each project aims to install 5,000 solar home systems through these concessions over a 5-year period (a combination of 20 Wp and 50 Wp systems totaling 125 kWp).

Concessions have been justified in these projects because:

- market surveys showed customers preferred sale of service to sale of equipment;
- concessions offer a service comparable to the type of service grid-connected customers benefit from (including comparable monthly payments);
- by lowering the up-front costs and transaction risks, the projects offer the opportunity to create a large customer base which can enable the private sector to operate on a commercial basis; and
- the approach helps establish a local private infrastructure.

A public agency, “Agence d’Electrification Rurale” (AER), in each country will be responsible for the project, including project preparation, service standards and monitoring, concession management and regulation, accounting and financial management, and capacity building. These agencies do not yet exist in either country and need to be established as part of the project. AER will be responsible for administering World Bank and GEF financing under the project. Ultimately the project envisions transfer of regulatory responsibility to a new regulatory agency expected to be established through the process of ongoing electric power sector reform. A key difference from the Argentina project is that AER purchases and owns the equipment and leases it to the concessions. So the contracts between the government and concessionaires include leasing provisions.

#### ***(d) Cape Verde Energy and Water Sector Reform and Development Project***

The World Bank/GEF Cape Verde Energy and Water Sector Reform and Development Project will select and promote a number of concessions for providing rural energy services (World Bank 1999b). The concessions will not have geographic monopolies but will be free to operate wherever they choose within a designated concession area. There will be two concession areas: one comprising Santiago island and the other comprising the remaining nine inhabited islands of Cape Verde. There will be no territorial limitation within the islands, permitting a concession, if it wishes, to compete with the providers of grid-connected electricity.

Concessions will be allowed for 10 years, which should provide adequate time for them to recover investment costs. The concession will be awarded by competitive tender, for which detailed bidding documents have been prepared. The project will encourage the formation of consortia of international firms experienced in the field of off-grid rural energy supply working in partnership with local entities. Consortia will be allowed to bid for both concessions and, in the event that they produce the best bid for both, amalgamate the two concessions into one. The Government of Cape Verde will have the right to terminate the concession at any time throughout its lifetime.

Concessions will have three main responsibilities:

*Sell off-grid electrification systems for either cash or credit.* The concessions will sell either complete systems or components, as required by the consumer. The sales will be made under normal retail/consumer arrangements, including equipment guarantees/warranties as appropriate. Components will be required to meet specifications as established by one of a number of internationally recognized testing bodies. Operators will be obliged to keep a sales and service office on the main islands of concern for the project, namely Santiago, Santo Antdo and Fogo.

*Sell electricity or electricity services.* Concessions will install, own and maintain installations in homes and public facilities. The concessions will provide a fee-for-service arrangement for consumers, where systems will be supplied to individual households and for other private use (e.g. in small businesses). The concessions will use proprietary funds, or those of cofinanciers, to invest in systems that they will continue to own. Concessions will set their own fees. Concessions will establish from the outset the levels of service it offers and will be expected to guarantee those to the consumer.

*Manage publicly owned equipment.* Concessions will act as agents for publicly owned equipment, including installation, maintenance, setting of tariffs and fee collection. The government of Cape Verde will hold regular tenders for this equipment, the size of the tender being based on the volume of private sales the operator has achieved. The concessions will supply, install and maintain the equipment, either for public services, such as street lighting, or in private households. Municipalities will choose equipment and applications. The national government will meet the capital costs of the equipment and either municipalities or individuals will pay the concession's fees.

#### ***(e) Peru Photovoltaic-Based Rural Electrification Project***

In Peru, rural communities wishing to electrify with renewable energy have organized small enterprises under the guidance of the Ministry of Energy and Mines. A number of different ownership and financing models exist, such as lease-hire, utility ownership, and user ownership. The UNDP/GEF Peru Photovoltaic-Based Rural Electrification project establishes model rural electricity concessions and local companies for rural off-grid electrification, based on the legal and regulatory framework established by the Electricity Concessions Act (GEF 1998c).

The project will develop different models in terms of ownership, participation, management, and tariffs. Local communities may establish their own rural electric utilities. The concession framework is explicitly left open in the project concept, but the basic idea is for local community-based concessions to install, own, operate and maintain renewable energy systems for the community. The government would contribute to these concessions, potentially as an equity investor. Operating and maintenance costs would be shared by monthly fees paid by the community and government subsidies. The concessions would be regulated by the Ministry of Energy and Mines.

The project expects to install 12,500 solar home systems in four years through the pilot concessions it will help establish, divided equally among four separate regions. In comparison, the total Peruvian market was estimated in 1998 at 1000 to 2000 systems per year. Within these four regions, the project has selected a total of 250 small communities without access to electricity and with at least 50 potential household customers. These concentrations of installations are expected to generate sufficient concentrated demand for spare parts and service to make the regions worthwhile markets for future investments.

***(f) Bolivia Renewable Energy-Based Rural Electrification Under the Popular Participation Law***

A number of rural renewable energy demonstration projects have occurred in Bolivia in recent years. Notably, the Netherlands has sponsored PV-based rural electrification using a rural cooperative (Cooperativa Rural de Electrificación) in the Department of Santa Cruz. That program subsidized the installation of 1000 PV systems and was seeking to expand using the private sector, monthly fees-for-service, soft-loans to end-users from municipal governments, and payment of import duties for system components by the departmental government of Santa Cruz (Jourde and Hemert 1999). Yet there is still no clear institutional model for village-based power. The 1994 Bolivia Popular Participation Law channels twenty percent of government revenues to municipalities, which can be used for rural renewable energy electrification.

The UNDP/GEF Bolivia “Renewable Energy-Based Rural Electrification Under the Popular Participation Law” project attempts to build on this earlier experience and pilot institutional models (GEF 1997). The project will help to identify rural electrification companies to procure, install and maintain the renewable energy systems. It will examine existing best practices for mixed public-private enterprises (required under the law for installations greater than 500 kW), identify options for harnessing public funds through the Popular participation Law, and draft and formulate standard contracts and terms of association for each option identified. Communities will be presented with a number of institutional options such as NGO provision, direct private contract, municipally-based options, and ultimately mixed public-private corporations.

The project envisions a mixed public-private “local electricity company” contracting with users for provision of services. Flat monthly fees would be charged for solar home systems, while per-kWh tariffs would apply to mini-hydro systems. The local electricity company would contract for maintenance and system support, and would receive subsidies from the government, as well as credit from private financiers. The public-sector participation in the company would be the municipal government; presumably this participation constitutes a form of regulation.

Project preparation identified 25 municipality-based projects where renewable energy would be economically and financially viable. Nine of these projects are mini-hydro, serving 1,200 households, while 16 are solar home systems projects serving 4,600 households.

### 3. TARIFFS AND SUBSIDIES

Three of the key issues in all of the above regulatory models are how to set consumer tariffs, how much of a subsidy to provide, and how often tariffs are reviewed and renegotiated. For the poorer segments of the rural population, tariffs are often discussed in terms of customer affordability and willingness to pay, and in relation to current expenditures on other energy sources and services like LPG, kerosene, batteries, and candles. With regulated concessions, tariff structures and renegotiation processes are crucial elements. Tariffs have to be flexible to allow for changing market or technology conditions, but must be controlled to provide maximum benefit from limited public funds.

Surveys of rural populations in five provinces in Argentina characterized off-grid households into four levels of monthly energy expenditures (Table 1). The World Bank/GEF project assumes that consumers cannot afford monthly payments for energy services higher than their current energy expenditures, regardless of the technology and the institutional arrangements used to supply them. Full tariff schedules to be regulated by the provincial governments include both an initial payment amount and a monthly payment amount over the life of the concession, and are based on total present worth of the investment plus operation and maintenance costs expected over the concession period of 15 years. Consumer tariff schedules are full tariffs less subsidies (both initial-payment subsidies and monthly subsidies). During the 15 year period, the concession, provincial government and provincial utility regulatory agency renegotiate the tariffs every 2 years.

Under this scheme, service to Type II and III households receives initial-payment subsidies from the provincial government of roughly 35% of the lifecycle costs of the system (including periodic battery replacement and maintenance costs). The remaining 65% of lifecycle costs are recovered from households as an initial-payment and monthly payments over the lifetime of the system. Service to Type I households receives the same first-cost subsidies and also receives monthly subsidies from the government at levels equivalent to those given for “lifeline” tariffs for urban households in grid-connected markets. In three representative provinces, these lifeline subsidy levels equaled \$4 to \$8 per month. This level of subsidy should cover the difference between the full monthly cost of a 50 Wp system and current energy expenditures by Type I households (a difference of about \$7 as shown in Tables 1 and 2).

**Table 1: Income Distribution and Energy Expenditures of Rural Households for Argentina project**

<b>Income type</b>	<b>Monthly income</b>	<b>Share of households</b>	<b>Approximate monthly energy expenditures</b>
I	< \$150	19%	\$10
II	\$150 to \$250	40%	\$15
III	\$250 to \$400	27%	\$25
IV	> \$400	14%	\$38

Source: World Bank 1999a.

**Table 2: Illustrative Full Economic Costs Per Installed Solar Home System (US\$) for Argentina Project**

<b>SHS size</b>	<b>Installation cost</b>	<b>O&amp;M (NPV)</b>	<b>Battery replacement (NPV)</b>	<b>Total</b>	<b>Monthly payment (full cost)</b>
50 Wp	764	390	216	1370	16.8
70 Wp	1074	390	299	1763	23.1
100 Wp	1347	390	418	2155	26.7

Note: assumes 14% discount rate, 15 year system life, and 20,000 household market size.  
Source: World Bank 1999a.

In Benin and Togo, market studies carried out by the project showed that current energy expenditures in the target zones range from \$5 to \$12 per month. It is expected that tariffs will be set in this range, which together with subsidies, will allow recovery of system costs over the life of the concession (15 years).

Proposed subsidies in Benin and Togo are structured so customers receive an up-front grant to cover the access fee they must pay the concession, plus a declining annual grant to cover service charges for up to five years. The annual grant amounts also depend upon the year a customer enters the program. After five years (or fewer if a customer enters the program after Year 1), customers are responsible for paying service charges without subsidies. For customers entering the program in the first year, the equivalent subsidies represent about 20-25% of the total lifecycle costs of a 50 Wp system.

In Cape Verde, a first-cost subsidy of up to \$150 will be provided for 20 Wp and 50 Wp solar home system. The subsidy amount declines for systems installed in later years of the project; by the fourth year, a 50 Wp system would receive only a \$30 subsidy.

Surveys in Peru show rural households in the project areas spend roughly \$9 per month on average on kerosene, candles, and batteries. In this project, customers will effectively receive an 80% subsidy for the initial capital costs of installations. The customer contribution, called an “association fee,” is expected to amount to about \$115 per household on average. Monthly fees for operations and maintenance remain to be determined and will probably vary by concession. Monthly fees may be subsidized separately by the government.

#### **4. SERVICE QUALITY**

Historically, the reasons for failure of rural energy projects included poor quality products, poor installation and maintenance, and systems being “oversold” (marketing claims that raise expectations higher than the technology can deliver). Codes, standards and certification are important elements to address these issues, as well as reduce commercial risks. In drawing up concession contracts, one of the challenges is how to require equipment specifications and performance in the contract between the concession and the customer. It is crucial that these

standards be verifiable through simple measurements. To the extent that contracts are adapted from on-grid electricity concessions, quality-of-service definitions from the on-grid contracts are probably inadequate.

In Argentina, technical assistance will be provided for establishing PV system performance standards and certification procedures and incorporating these into concession contracts. PV system standards are being adapted from European standards (EU 1998). A provincial utility regulatory agency will verify compliance with the provisions of the concession contract and will carry out certification procedures.

In the Benin and Togo projects, technical assistance will strengthen the capacity of AER to contract, regulate and monitor the rural energy concessions. AER will prepare standard customer service contracts, issue and enforce a “PV code of practice” and PV system technical standards, manage an accreditation program for local technicians, conduct inspections on installed systems according to agreed quality control procedures, and conduct regular consumer surveys on system performance and customer satisfaction. In addition, the concessions will provide a manufacturer’s guarantee for the systems supplied and performance bonds for maintenance.

The Cape Verde project will rely on concession-supplied equipment that meets certain minimum standards. Because Cape Verde is too small for national standards to be prepared cost-effectively, concessions will have a choice of international standards to apply. The project will help to identify appropriate standards and testing institutions.

The Bolivia project will help the Bolivian National Institution of Standards and Quality to finalize photovoltaic and wind energy equipment standards it has been working on, and to develop a certification program.

The Peru project provides technical assistance for developing PV systems standards and recommended certification practices and training installation technicians.

## **5. OTHER REGULATORY AND CONTRACTING ISSUES**

Some of the key regulatory and contracting issues associated with concessions, based on project experience, workshops and interviews with practitioners, are described in this section.

***Bundling of rural services.*** Delivery of services to rural populations is expensive. Marketing, sales, and service involve many activities like information dissemination, installation, fee-collection, maintenance and warranty service, reclamations, after-sales customer services, and non-payment interventions. One way to reduce the high transaction costs may be to bundle energy services with other existing services (e.g. water, communications, financial services, or consumer electronics sales and service). The development impacts of service bundling have been noted by the World Bank, which estimated increasing development benefits with the addition second-, third- and fourth-services—i.e., the added benefit of the fourth service, given

three existing services, is much greater than the added benefit of the second service (World Bank 1999c).

***Terms of concessions and mechanisms for terminating concessions.*** The design of incentives and risk allocation in a concession contract will affect first the intensity of competition and then the sustainability of the original contract (Klein 1998a). Regulatory frameworks need to assure that the phasing out of the concession will not be hindered by the responsible local regulatory or other interested parties whose function or business would be eliminated or curtailed with the end of the concession.

***Attracting capable bidders.*** There may be a substantial challenge in getting enough qualified bidders to respond to a tender. Potential domestic and international bidders may be hesitant to participate in bidding because of lack of tested experience with the regulatory framework and process and lack of reliable information on costs and profits. Regulators need to carefully consider who are the potential bidders and what their concerns are. Subsidies may be attractive to bidders, but the regulatory framework may be a more decisive factor. Regulators should consider active ways to interest potential bidders (e.g., seminars on rural electrification issues for international utilities, and on concession business plans for local companies), and ways to promote joint ventures or bidding partnerships between local and international firms. For example, in the Argentina PAEPRA program, two provincial governments wanted to award separate urban and rural concession contracts but not enough capable bidders could be attracted for the rural concessions. So the rural and urban concession contracts were bid together.

***Bidding process design, competition, negotiation, and rebidding.*** Formal competitive bidding takes time, is costly, and may discourage innovation. Negotiated contracts may be much quicker but more costly and be less politically acceptable. Many other decisions about how to structure a competitive bidding process can greatly affect the outcome. For long-term concession contracts, renegotiation can diminish the importance of initial competitive bidding and affect costs. If concession contracts are subject to periodic rebidding, then service adjustments (costs, prices, etc.) can be made competitively and continued competition may decrease the need for price regulation (Klein 1998b, 1998c, 1998d).

***Relevance of rural service experience.*** In some circumstances, such as has happened in Argentina, existing concessions in urban areas may be granted the opportunity or required to serve the rural off-grid market. If this happens, there arises the question of whether the urban concession is willing or able to service the rural market and whether it is familiar with the technologies and service infrastructure needed. One solution would be to encourage the concession to partner with other firms, foreign or domestic, that have experience in serving rural markets or with the technologies concerned. A better solution may be to fully separate the two markets.

***User participation.*** Participation of technology users is crucial for project success. This social challenge of rural electrification may be easier to handle by concession. One typical example is the challenge how to regulate the demand of individual households in a minigrid (community use of a limited resource). User participation is complicated by the distribution of user demand;

typically, many users have low demand, while a few have much higher demand for energy services.

***Equipment selection, purchase vs. leasing.*** If concessions can choose the technologies to offer users, will they offer least-cost types of technology? The Argentine projects seem to think so, and allow concessions complete freedom in equipment selection. In Benin and Togo, conversely, technologies are specified by the project management unit and leased to the concessions; this allows economies of scale and standardization in purchasing, and relieves the concessions of needing skills for competitive procurement, but also takes away the concession's ability to vary technology according to user needs and to achieve least-cost applications.

***Regulatory Agency Capability And Performance.*** Regulation of concessions is quite different from traditional regulatory practices for state-owned electric utilities. In countries with traditionally state-owned, state-managed utilities, regulatory oversight may not have existed at all. Even where utilities have been privatized and new regulatory mechanisms established, new regulatory skills will be needed for rural energy concessions. Among the biggest challenges in regulatory design are achieving political independence and introducing rules to ensure accountability (Estache 1997). Projects recognize this issue and provide ways to increase regulatory agency capabilities. For example, the World Bank/GEF Argentina project provides technical assistance to the provincial governments for concession bidding and contracting, training of agency staff, and monitoring and regulation of concessions.

## 7. CONCLUSION

The regulatory, institutional, and financing challenges of concessions are large. There still is a long way to go in the evolution of best practices for contracting, operating, and regulating rural energy service concessions—and in understanding the most appropriate types of concession in different contexts. Conditions in Argentina, for example, appear conducive to concessions, but this may not be true elsewhere. In Argentina, the grid-connected parts of the electricity distribution system and other infrastructure have already been developed into concessions, so there is a well-trodden policy, legal and procurement path which makes it possible to do this in Argentina. Concessions are also attractive where there are no existing energy service providers and/or in very small markets, and indeed this is the approach that the Government of Cape Verde has adopted for rural provision to households. Still, even in Argentina, many implementation and regulatory issues have yet to be fully worked out.

The six country cases and their regulatory approaches are summarized in Table 3. The cases represent a variety of approaches, including regulated monopolies, open-market providers, and community-based services. The experience from these cases, as projects and programs are implemented, should be carefully monitored for lessons being learned and relevance to the objectives of least-cost rural electrification and rural development. Still, it is important not to see the concession approach as a “silver bullet” to the problem of access to electricity.

Finally, more analytical work is needed. The use of concessions for rural off-grid renewable energy is relatively recent in rural development practice. Although there is a considerable

amount of existing knowledge on concessions in other applications, including village-scale mini-hydro schemes and grid-connected electricity generation, the literature on concessions in other applications and sectors has not been analyzed sufficiently for its relevance to rural electrification concessions. This is a fruitful avenue of research and there are on-going efforts by the World Bank and others to do so (World Bank/ESMAP 2000).

**Table 3: Summary of Regulatory and Contractual Features from Case Studies**

	<b>Argentina</b>	<b>Benin/Togo</b>	<b>Cape Verde</b>	<b>Peru</b>	<b>Bolivia</b>
	<b>(Renewable Energy in the Rural Market)</b>	<b>(Decentralized Rural Energy)</b>	<b>(Energy and Water Sector Reform and Development)</b>	<b>(Photovoltaic-based Rural Electrification)</b>	<b>(Renew. Energy-Based Rural Electrification )</b>
Geographic monopoly for concession	Yes; by province	Yes; selected “project areas”	No; gains market rights & subsidies, but must compete with others	Community based, but not necessarily monopoly	Community based, but not necessarily monopoly
Regulator	Provincial governments and existing provincial utility regulatory agency	Newly established national agency “Agence d’Electrification Rurale”	Project Management Unit during project; thereafter “independent utilities regulator”	Ministry of Energy and Mines	Municipal governments (also through equity investments in the concession)
Concession term	15 years	15 years	10 years	Not stated	Not stated
Concession renewable	Yes, to 45 years	Yes, to 40 years	No; competitive market established after 10 years	Not stated	Not stated
Bundling with other services	Possible	No	Possible	Possible	No
Competitive bidding vs. negotiated contracts	Negotiated contract if urban concession exists and is willing, otherwise bidding	Competitive bidding	Competitive bidding	Not stated	Not stated
Purchase vs. leasing by concession	Purchase on open market	Lease from project management agency (regulator)	Purchase on open market	Purchase on open market	Not stated
Technology choice	By concession	By project management agency (regulator)	By concession	By concession	Initially by project/regulator
Up-front payment by customer	Yes; Roughly \$100 (for 50 Wp)	Yes	Decided by concession	Yes; Roughly \$100	Yes; 10% of system cost
Subsidies	Up-front grant of roughly 35% of system lifecycle costs; declines in later years of project; additional subsidies to low-income groups	Up-front grant and yearly grant for up to five years, covering up to 25% of system lifecycle costs; declines in later years of project	Up-front grants of 30% for 20 Wp household system; 15% for 50 Wp household system; 25% for 50 Wp public lighting system	80% subsidy for installed system costs; constant over life of project	At least 35% for PV projects and 20% for mini-hydro projects
Service standards and monitoring	PV system performance standards  Certification procedures for installers	PV code of practice  PV system technical standards  Accreditation program for technicians  Inspections on installed systems  Customer surveys	International standards used  Equipment meets “certain minimum standards”  Project Management Unit supervision	PV systems standards  Recommended certification practices  Training for installation technicians  Random inspections	Equipment standards  Certification program

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