Remote access

Expanding energy provision in rural Argentina through public-private partnerships and renewable energy

A case study of the PERMER programme

Sarah Best

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Sustainable Development Advisors

This case study, prepared by Sustainable Development Advisors for the International Institute for Environment and Development, analyses the delivery model and impacts of the Argentine government's programme for off-grid electrification in rural markets, known as 'PERMER' (Proyecto de Energías Renovables en Mercados Rurales).

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For further information please contact:
International Institute for Environment and Development (IIED)
3 Endsleigh Street
London WC1H 0DD
United Kingdom

newbooks@iied.org
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Cover Photograph: The photo is of Lucio Domingo Peñalos, Headmaster of Escuela Provincial No 208, Quirquincho, Yavi Department, Jujuy, and shows a solar cooker in the foreground and in the background a solar water tank, both installed by PERMER.

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About the author

Sarah Best formerly worked in Argentina with the consultancy Sustainable Development Advisors. Now based in the UK, Sarah is a policy adviser with Oxfam GB, where she focuses on low-carbon development. Her background is in advocacy and research on climate change, labour rights and the social impacts of business and she has worked with a range of organisations, including Oxfam, the International Labour Organisation, Shell International and the Confederation of British Industry. Sarah holds an MPhil in Development Studies from the Institute of Development Studies, Sussex University.

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Sustainable Development Advisors (SDA) provide sustainable development consultancy for international project development and project financial advisory services to a wide range of market sectors, including renewable energy, climate change and public-private partnerships. Based in Buenos Aires, the core team of SDA has more than 30 years' experience of project structuring and public sector advisory experience, and is backed up by a group of multinational strategic partners with comprehensive worldwide experience in technical, environmental, social, economic, financial, legal and regulatory issues. Due to those long-lasting strategic partnerships SDA benefits from a wide support network of consulting expertise to work with public and private sector clients and projects around the region, in which it has undertaken over 50 advisory assignments with multilateral finance institutions, governments and the private sector.

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Acronyms

EJESA
Empresa Jujeña de Energía S.A. (Jujuy Energy Company)

EJSEDSA
Empresa Jujeña de Sistemas Energéticos Dispersos (Jujuy Company for Dispersed Energy Systems)

ENRE
Ente Nacional Regulador de la Electricidad (National Electricity Regulatory Body)

FCT
Fondo Subsidiario para Compensaciones Regionales de Tarifas a Usarios Finales (Subsidy Fund for Compensating Regional Tariffs for Final Users)

FEDEI
Fondo Especial de Desarrollo Eléctrico del Interior (Special Fund for Electricity Development in the Interior)

FNEE
Fondo Nacional de Energía Eléctrica (National Fund for Electric Energy)

GEF
Global Environment Facility

INDEC
Instituto Nacional de Estadística y Censos (National Statistics and Census Institute)

NGO
Non-governmental organisation

PAEPRA
Programa de Abastecimiento Eléctrico a la Población Rural Dispersa de Argentina (Programme to Supply Electricity to the Dispersed Rural Population in Argentina)

PERMER
Proyecto de Energías Renovables en Mercados Rurales (Project for Renewable Energy in Rural Markets)

PROMER
Proyecto de Mejoramiento de la Educación Rural (Programme to Improve Rural Education)

Su.Se.Pu
Superintendencia de Servicios Públicos o Otras Concesiones (Regulator of Public Services and Other Concessions)

SHS
Solar Home System

UCP
Unidad Coordinadora del Proyecto (Project Coordination Unit)

UEP
Unidad Ejecutiva Provincial (Provincial Executive Unit)

VAT
Value added tax

Wp
Watio pico (Peak Watts)

1 Executive summary

The Argentine government's programme PERMER (Project for Renewable Energy in Rural Markets), introduced in 1999, provides electricity for basic lighting and social communication (radio, TV) needs for families and public services in remote rural areas that are beyond the reach of the grid. The purpose of this case study is to describe and analyse:

- the delivery model adopted by PERMER for reaching isolated or dispersed rural customers
- the state of implementation of the programme to date
- the barriers and levers to progress in programme implementation, and lessons learned
- the social impacts on users, focusing on residential users and schools.

The study focuses on Argentina's north-eastern province of Jujuy, which is one of the poorest and most remote parts of the country, and one of the first provinces to implement PERMER (See Annex A for a map of Argentina).

The delivery model adopted by PERMER is a public-private partnership, which combines significant government funding to install generating equipment and to subsidise user tariffs, with the award of exclusive contracts to concessionaires (private sector, public sector, co-operatives) who run and maintain the service. It is co-ordinated at the federal level by the Energy Secretariat, with provincial governments leading the programme implementation and regulating service contracts. Financing comes from a mixture of international loans and grants from the World Bank and the Global Environment Facility (GEF), together with education and energy sector funds, provincial budgets, user fees and – at least in the first phase of PERMER – corporate investments. User tariffs are decided by provincial governments in negotiation with the concessionaires, with the tariff levels set varying according to local conditions, such as people's capacity or willingness to pay.

"PERMER has provided basic electricity access to 10,000 households and 1,800 schools and other public service buildings. It aims to reach another 18,000 households"

It is a largely a technically-driven, top-down programme, focused on increasing electricity connections. There is community involvement, principally in terms of individuals deciding if they want the service or, in the case of mini-grids, agreeing whether and where construction takes place. In general, participation is focused on information provision and risk management, rather than communities determining what energy services are required or managing local energy provision. The programme is technology neutral, with a strong emphasis on renewable energy. While the majority of installations are solar photovoltaic (PV) panels, PERMER also involves renewable and hybrid mini-grids (wind, hydro, biomass, diesel), and solar systems for water heating, cooking, space heating and water pumping.

Following long delays, funding constraints and design changes during its early years, PERMER is now considered a broadly successful programme by the Argentine government and international funders. In ten years since its initiation, PERMER has provided basic electricity access to around 10,000 households and 1,800 schools and other public services buildings. In its current phase, the programme aims to reach another 18,000 households. Concessionaires' performance in maintaining and repairing equipment varies, but overall, relatively good standards of maintenance are considered one of the strengths of the programme by PERMER and World Bank officials. The main benefits for families and schools with solar panels include:

- better quality, and safer, illumination, which replaces kerosene lamps and candles
- an extended serviceable portion of the day, with family members able to use light in the evenings for activities such as studying, reading or handicrafts, listen to the radio and – occasionally – watch television
- a service whose direct cost to the consumer is equivalent to, or cheaper than, residents' previous energy sources
- in schools, more and better lighting, allowing early morning classes, as well as evening study or class preparation time for resident pupils and teachers
- the use of new teaching aids in schools, like radios, stereos, TVs and computers
- greater community usage of the school e.g. for sewing workshops or social events.

There have also been criticisms of PERMER, the main one being that the rate of implementation has been slow, and the number of installations achieved fewer than what was first aimed for. In addition, the level of power supply is low: many families and public services want more power, for instance, for more lights, TV and PC usage, refrigeration, water pumping and other productive activities. Among private-sector concessionaires, a key criticism is that their business is not profitable due to low tariff levels set by provincial governments. In addition, PERMER has little impact in terms of stimulating domestic equipment manufacturing suitable for power supply conditions in rural communities.

"A concession-based approach can help create a sustainable service – but only with the right institutional, market, financial and regulatory conditions in place"

Behind these challenges lies a range of political, institutional, economic, technical, geographic, capacity and programme design issues. These have included:

- Economic constraints. The 2001 economic crisis in Argentina, and the austerity measures that followed, were a major barrier to programme implementation, since they led to rising solar PV prices and subsidies on one hand, and budgetary cuts and a reduction in key PERMER staff on the other. Although the economy is in better shape now, lack of provincial funds continues to hinder faster progress.
- A rigid delivery model, which placed too-high expectations on the private sector. This caused barriers to PERMER's implementation in some provinces, which had not privatised electricity services.
- Institutional and capacity barriers, particularly in provincial governments. Here, progress has been delayed due to factors such as resource and staff capacity restraints, regulatory weaknesses, and insufficient political interest in rural populations.
- Bureaucratic barriers, including the delays involved in renegotiating World Bank loan terms and in aligning provincial procurement processes to Bank rules.
- Geographic barriers, as users' physical distance and isolation made logistics hard to organise, with the firms supplying equipment often underestimating logistical costs.
- Lack of understanding of renewable energy issues by government actors, concessionaires, technicians and users, creating challenges in programme implementation, incorrect installation or incorrect use of equipment, particularly during the early phases of PERMER.
- Unwillingness of some concessionaires to serve rural markets.
- Lack of broader policy and institutional framework, or economic incentives, to stimulate green industries in Argentina, which could supply equipment.

Based on the national overview, and the particular experience with solar PV installations in homes and schools in Jujuy, some of the key lessons learned by PERMER to date are:

- A concession-based approach can help create a sustainable service – but only with the right institutional, market, financial and regulatory conditions in place.
- Serving highly dispersed, isolated, low-income populations is not commercially attractive for private sector providers on their own in countries or areas with similar conditions to Jujuy/Argentina, and significant subsidies are required.
- Delivery models must be flexible to cope with the local diversity, such as national or sub-national differences in market structures, types of service provider and geographic contexts.
- Subsidies must be adequate, ring-fenced and obtained from reliable, sustainable sources.
- International loans and grants have been critical for PERMER, but the conditions set must be flexible and country-led so that implementing models can respond to local conditions and economic cycles.
- Ambitious, complex, nationwide programmes like PERMER require major time, costs and effort in their early stages of development, which should be factored into targets, planning timelines and goals.
- The attitude of provincial ('sub-national') governments and of concessionaires is crucial to progress; a specific 'marketing' and capacity building initiative can help build their interest and commitment.
- Success and sustainability depend on training with users, technicians, service providers, government institutions, regulators and local development groups (e.g. NGOs) to ensure proper selection, installation and use of equipment, and good regulation of the service.
- While raising awareness within communities is always crucial, the level of participation and types of approach may vary according to the type of project, technology and local social context.
- Programmes must be designed to ensure users with low-power generating equipment can buy and use appropriate low-power appliances. This could involve, for example, approaches focused on the purchase of low-cost, foreign products or, if there is sufficient domestic demand, an initiative to stimulate a domestic supply industry.
- To reduce poverty and create productive opportunities, electrification projects like PERMER need to be integrated with rural development plans and programmes, that involve all relevant ministries, are rooted in community participation and address a wide range of energy needs.
- Creating local green industries and jobs for equipment supply and maintenance requires a broader enabling environment, including a strengthening of national policy, institutions, regulation and economic incentives, and potentially adapting government or institutional lenders' procurement rules so that they encourage local suppliers.

"Access to solar power has improved people's daily living by extending the active day through better quality illumination"

Solar panel on health post next to church in Suripujio, Jujuy.

1
Resumen Ejecutivo

"PERMER ha proveído de acceso a la electricidad básica a más de 10,000 hogares y 1,800 escuelas y otros edificios de atención pública. El programa pretende alcanzar otros 18,000 hogares."

El Programa de Energías Renovables en Mercados Rurales (PERMER) del gobierno de Argentina, introducido en 1999, provee electricidad y comunicación (radio y televisión) a familias e instituciones de servicios públicos en comunidades rurales remotas que se encuentran fuera de la Red de Electricidad Nacional. El propósito de este estudio es describir y analizar:

- El modelo adoptado por PERMER para alcanzar clientes de áreas rurales, aisladas o dispersas geográficamente,
- El estado de implementación del programa a la fecha,
- Las barreras y los factores favorables que influyen en el progreso en la implementación del programa, así como las lecciones aprendidas, y
- Los impactos sociales en los usuarios, enfocándose en usuarios residenciales y escuelas.

El estudio se enfoca en la provincia de Jujuy, al noroeste de Argentina, la cual es una de las zonas más pobres y remotas del país y una de las primeras provincias en implementar el programa PERMER (Ver anexo A, Mapa de Argentina).

El modelo de reparto o distribución adoptado por el PERMER se basa en asociación público-privada, la cual combina un nivel significativo de financiamiento público para instalar equipos de generación y para subsidiar las tarifas de los usuarios, con el otorgamiento de contratos exclusivos a concesionarios (del sector privado, público y cooperativas) que proveen y mantienen el servicio. Es coordinado al nivel federal por la Secretaría de Energía, y los gobiernos provinciales se encargan de la implementación del Programa y la regulación de los contratos por servicios. El financiamiento proviene de una mezcla de préstamos y donaciones internacionales del Banco Mundial y el Global Environment Facility (GEF), fondos del sector de Educación y Energía, presupuestos provinciales, tarifas pagadas por los usuarios, y, al menos en la primera fase del PERMER, de inversión corporativa. Las tarifas de los usuarios se fijan por los gobiernos provinciales en negociación con los concesionarios, y las mismas varían de acuerdo a las condiciones locales, tales como la capacidad o la disposición a pagar de la gente.

El PERMER está guiado por criterios técnicos y una toma de decisiones jerárquica (top-down), enfocado en incrementar el servicio de conexiones eléctricas. La participación de la comunidad se da en términos de la aceptación del servicio por los miembros de la misma, o en el caso de la instalación mini – redes, acordando cuando y donde la construcción debe tomar lugar. En general, la participación se centra en la provisión de información y la gestión de riesgos, más que en la determinación por las comunidades acerca de cuáles son los servicios de energía que se requieren o en el manejo del suministro de energía local. El programa es neutral en cuanto a la tecnología, con un fuerte énfasis en las energías renovables. Si bien la mayoría de las instalaciones son de paneles solares fotovoltaicos (FV), el PERMER también utiliza otras energías renovables y mini-redes híbridas (eólicas, hidráulicas, de biomasa o diesel), así como sistemas solares para calentar agua, cocinar, para la calefacción y el bombeo de agua.

Después de una serie de largos atrasos, restricciones en el financiamiento y cambios de diseño durante los primeros años, el PERMER se considera ahora un programa exitoso por el gobierno de Argentina y los contribuyentes internacionales. A diez años de sus inicios, el PERMER ha proveído de acceso a la electricidad básica a más de 10,000 hogares, 1,800 escuelas y otros edificios de atención pública. En su etapa actual, el programa pretende alcanzar otros 18,000 hogares. El desempeño de los concesionarios en el mantenimiento y reparación de equipos varían, pero en general, los relativamente buenos estándares de mantenimiento se consideran una de las fortalezas del programa por el PERMER y los funcionarios del Banco Mundial. Los principales beneficios para las familias y escuelas con paneles solares incluyen:

- Iluminación de mejor calidad y más segura, que reemplaza a las lámparas de kerosene y las velas.
- Una mayor porción del día útil para las familias, pudiendo utilizar la luz eléctrica en actividades como el estudio, la lectura, las manualidades, escuchar radio, y, ocasionalmente, ver televisión.
- Un servicio cuyo costo directo al consumidor es equivalente, o más económico, que las anteriores fuentes de energía disponibles para los residentes.
- En las escuelas, una mejor y mayor iluminación, permitiendo clases en horas más tempranas de la mañana, así como estudio en la tarde, o tiempo adicional para la preparación de clases para los profesores y estudiantes.
- El uso de nuevos instrumentos de enseñanza en las escuelas, tales como radios, estéreos, televisión y computadoras.
- Un mayor uso de la escuela por parte de la comunidad, por ejemplo para talleres de costura y eventos sociales.

También han habido críticas para el PERMER, siendo la principal de ellas que la tasa de implementación es lenta y que el número de instalaciones es menor a lo planteado. Adicionalmente, el nivel de suministro de energía es bajo: muchas familias e instituciones de servicio público, desean contar con un mayor suministro de electricidad, por ejemplo, para tener mayor iluminación, uso de la televisión y de computadoras, refrigeración, bombeo de agua y otras actividades productivas. Entre los concesionarios del sector privado, una crítica fundamental es que el negocio no es rentable debido a las bajas tarifas fijadas por los gobiernos provinciales. Además, PERMER, tiene un impacto menor en el estímulo a producción nacional de electrodomésticos adecuados a las condiciones de provisión de energía en las comunidades rurales.

Detrás de estos desafíos se encuentra una serie de restricciones políticas, institucionales, económicas, técnicas, geográficas, de capacidad y de diseño del programa. Estas incluyen:

"Un enfoque basado en concesiones puede ayudar a crear un servicio sostenible, pero solamente cuando existen las condiciones institucionales, de mercado, financieras y de regulación adecuadas"

- Limitaciones económicas. La crisis económica del 2001 en Argentina y las medidas de austeridad que siguieron, fueron la mayor barrera para la implementación del programa, ya que provocaron un aumento en los precios de los paneles solares fotovoltaicos y de los subsidios por un lado, y por el otro, los recortes en el presupuesto y en el personal clave del PERMER. Aunque la economía se encuentra hoy en día en un estado mejor, la falta de fondos provinciales continúa siendo una barrera para un progreso más rápido.
- Un modelo muy rígido de distribución, el cual pone expectativas muy altas en el sector privado. Esto causa barreras para la implementación de PERMER en algunas provincias, que no han privatizado aún sus servicios de electricidad.
- Barreras institucionales y de capacidad, particularmente en gobiernos provinciales. Aquí, el progreso ha sido retrasado debido a factores tales como las restricciones en los recursos y en la capacidad del personal, debilidades regulatorias, así como una falta de interés político en las poblaciones rurales.
- Barreras burocráticas, incluyendo los retrasos por la renegociación en los términos de los préstamos con el Banco Mundial, y en la alineación de los procesos de contratación provinciales con las reglas impuestas por el Banco.
- Barreras geográficas, ya que el aislamiento y la distancia geográfica de los usuarios hizo que el proceso logístico sea más difícil de organizar, provocando muchas veces que las firmas proveedoras de los equipos subestimen los costos logísticos.
- Falta de entendimiento sobre los temas de energía renovable por los actores del gobierno, concesionarios, técnicos y usuarios, creando desafíos en la implementación del programa, instalaciones no adecuadas, o indebido uso del equipo, particularmente durante las primeras fases de PERMER.
- Falta de disposición de algunos concesionarios para atender a los mercados rurales.
- Ausencia de un marco institucional y de políticas más amplias, o de incentivos económicos para estimular industrias verdes en la Argentina, que podrían proveer los equipos.

Sobre la base de una perspectiva nacional, y de la experiencia particular con las instalaciones de energía solar fotovoltaica en casas y escuelas en Jujuy, algunas de las lecciones aprendidas por el PERMER a la fecha son:

- Un enfoque basado en concesiones puede ayudar a crear un servicio sostenible, pero solamente cuando existen las condiciones institucionales, de mercado, financieras y de regulación adecuadas.
- Dar servicio a comunidades con poblaciones altamente dispersas, aisladas o de bajo ingreso económico, como las de Jujuy, en Argentina, no es comercialmente atractivo para los proveedores del sector privado por sí solos, por lo que se requieren importantes niveles de subsidio.

- Los modelos de provisión deben ser flexibles para acomodarse a la diversidad local, tales como las diferencias en las estructuras de mercado, los tipos de proveedores del servicio y los diferentes contextos geográficos.
- Los subsidios deben ser adecuados, bien definidos y provenientes de fuentes confiables y sostenibles.
- Los créditos y las donaciones internacionales han sido críticos para el PERMER, pero las condiciones fijadas deben ser más flexibles y ser definidas por el país receptor, de tal manera que los modelos de implementación respondan a las condiciones locales y a los ciclos económicos.
- Los programas ambiciosos, complejos y de cobertura nacional, tales como PERMER, requieren un mayor tiempo, costos y esfuerzo en las primeras etapas de desarrollo, lo cual debe reflejarse en los propósitos, los cronogramas de planificación, y las metas.
- La actitud de los gobiernos provinciales ('sub-nacionales') y de los concesionarios es crucial para el progreso; un 'marketing' específico y una iniciativa de desarrollo de capacidades pueden ayudar a construir interés y compromiso.
- El éxito y la sostenibilidad dependen del entrenamiento con los usuarios, técnicos, proveedores del servicio, instituciones gubernamentales, reguladores y grupos de desarrollo local (por ejemplo, ONGs) para asegurar una selección apropiada del equipo, su instalación y uso y una buena regulación del servicio.
- Mientras que elevar los niveles de conciencia de las comunidades es siempre crucial, el nivel de participación y los tipos de enfoque pueden variar por tipo de proyecto, tecnología utilizada y por el contexto social en cada comunidad.
- Los programas deben diseñarse asegurándose que los usuarios con generadores de bajo voltaje puedan adquirir y utilizar electrodomésticos apropiados. Esto podría involucrar, por ejemplo, la compra de electrodomésticos extranjeros de bajo costo, o, si la demanda lo justifica, una iniciativa para estimular una industria local de suministro.
- Para reducir la pobreza y crear oportunidades productivas, los proyectos como el PERMER necesitan estar integrados con planes y programas de desarrollo rural, que involucren a todos los Ministerios relevantes, estén basados en la participación comunitaria y atiendan una amplia gama de necesidades energéticas.
- La creación de industrias y empleos locales verdes para el suministro y mantenimiento de equipos requiere la existencia de un entorno propicio más amplio, incluyendo el fortalecimiento de las políticas nacionales, de las instituciones, de la regulación y de los incentivos económicos, y potencialmente, la adaptación de las reglas de contratación de los gobiernos y de los prestadores institucionales para alentar a los proveedores locales.

2
Context of PERMER and rural electrification in Argentina

This section sets the broader context by outlining key features of the electricity sector and the origins of PERMER. The key points are that:

- Despite high rates of electrification, Argentina still faces pressing energy poverty issues in urban and rural areas.
- The poverty and highly dispersed nature of rural populations makes the costs of serving them through grid networks prohibitively high.
- The origins and design of PERMER are closely linked to Argentina's privatisation of its electricity sector.
- Argentina has strong potential for using renewable energy in general, but this is underexploited due to a range of policy, institutional and financial constraints.

As a middle-income country, with high rates of human development and over 95 per cent of its population connected to the grid, Argentina rarely features in debates around energy poverty and development. However, the country has faced – and still faces – pressing energy needs among its low-income populations, both in urban and rural areas. These cover not just electricity, but energy for cooking, water heating and pumping, heating, refrigeration, motive power and other purposes, in homes, enterprises and in public services. An assessment by the energy research institute, Fundación Bariloche, estimated that in the early 2000s – when Argentina was in economic crisis and poverty rates soared to over 50 per cent – almost 20 million poor and indigent people, the majority of whom lived in urban areas, were not consuming the average energy needed to cover their minimum requirements. The authors highlight how energy needs varied by context. In urban areas, the main gaps were energy for cooking, water and home heating. Among the dispersed, rural populations, electricity access and mechanic power for productive activities were key requirements, alongside energy for cooking and heating in homes (Fundación Bariloche, 2005).

The Argentine electricity sector has a similar structure to that of the UK and many other industrialised economies. Argentina 'unbundled' and privatised centralised, state-owned infrastructure and utilities under President Menem's government in the early 1990s. At the time PERMER was being developed, electricity generation and transmission had already been privatised and distribution companies, mainly owned by provincial governments, were in the process of being so. While electricity generation markets are competitive, distribution concessionaires receive exclusive coverage to their designated area. As will be discussed shortly, PERMER was specifically designed to be compatible with the new pattern of private ownership and market structure (World Bank, 1999; Covarrubias and Reiche, 2000).

"The poverty and highly dispersed nature of rural populations makes the costs of serving them through grid networks prohibitively high"

Argentina has a federal system of government, with national energy policy set by the Energy Secretariat, which is based in the Ministry of Infrastructure, Federal Planning and Services. The Secretariat co-ordinates the delivery of energy services in Argentina´s 23 provinces and in the Autonomous City of Buenos Aires. Regulation and supervision of the power sector is shared between the National Electricity Regulator (ENRE) and provincial regulators, with the latter responsible for setting the retail tariffs for distribution utilities (except in the city of Buenos Aires and La Plata, which falls within ENRE's remit). Generation capacity in Argentina is dominated by natural gas and oil (50-60 per cent) and large-scale hydro (30-40 per cent), with nuclear making up a smaller share (4-9 per cent). While Argentina´s abundant natural resources signal that it has strong potential for renewable energy (RE), particularly in terms of wind, hydro, solar and biomass, these resources are underexploited, and the existing share of renewables in electricity generation is less than 2 per cent. This share mostly comprises wind power and small-scale hydro (Bloomberg, 2009).

There are several reasons for this under-exploitation of renewable sources of energy, including an inadequate policy framework, lack of economic incentives, weaknesses in institutional coordination, high investment costs and perceived risks, and insufficient local development of the equipment production and maintenance industry (Fundación Bariloche, 2005). This situation may change, as the government has started to strengthen its policy framework. In 2006, it introduced a law which sets a target of 8 per cent of power generation from renewable energy sources by 2016, provides feed-in tariffs for renewable energy (excluding large hydro) and tax breaks to encourage domestic equipment supply (Bloomberg, 2010; REEEP, 2009).

When the privatisation process started, electrification rates were already high in Argentina. However, power sector reforms did little to extend access in rural areas.

When the PERMER programme started, around 30 per cent of the rural population (1.6 million people) – or 5 per cent of Argentina´s total population – still lacked access to electricity (Alazraki and Haselip, 2006). The government faced several barriers in terms of trying to extend access to these populations, which included:

- **Geographic factors.** The huge size of Argentina's territory , and the highly dispersed, isolated nature of many populations in rural areas, make investment costs in electricity distribution in these areas very high. Argentina is around 2.8 million square kilometres – which is almost the size of India – but has a population of just 40 million (compared to more than 1 billion in India). The vast majority of Argentina's population (92 per cent) lives in urban areas, and population density in rural areas is extremely low. These factors, together with the poverty and low consumption potential of rural customers, meant that these markets were not commercially attractive and often not suited to grid extensions.
- **Budget constraints.** The limited financial capacity of provincial governments meant there were insufficient funds for investing in and subsidising services.
- **Institutional weaknesses.** Many provincial regulatory agencies did not have the capacity to effectively regulate private sector operators or rural markets, and had no experience of supervising services based on renewable energy technologies (World Bank, 1999).

To address these challenges and serve rural, dispersed populations, the Argentine government, with financing from the World Bank and the GEF, in 1999, initiated the PERMER programme. Emerging from an earlier programme of the Secretary of Energy, known as PAEPRA, PERMER aimed to provide electricity for basic lighting and social communication (small TV and radio appliances) for uncovered households and public service institutions.

3 Overview of PERMER goals and model

This section describes the goals of PERMER, the key elements of its delivery model and how and why this has evolved over time. It also explains the institutional players and structure, the financing arrangements, the role of communities and evaluation and monitoring systems.

The key points are:

- PERMER is a mixed public-private programme, led by the federal government and implemented by provincial authorities, and involving private sector firms, co-operatives and state companies who provide, install and maintain electricity generation equipment.
- The delivery model was amended several times so it adapted to the reality of local conditions and to the impact of the 2001 crisis, in particular by reducing its expectations on the level of private sector involvement.
- The majority of financing comes from international loans, national and provincial budgets, with contributions from users and, in some instances, from companies too.
- There are heavy subsidies for installation and tariffs, set according to local conditions
- It is a largely top-down programme, with community involvement varying from basic information provision to more participatory decision-making, depending on the type of technology used, the social or environmental risks, or the presence of indigenous groups.

Table 1
Numbers of Individual Users and Public Services Targeted and Achieved

PHASE	TIME FRAME		MAXIMUM TARGETED INSTALLATIONS (i)	NO. OF COMPLETED INSTALLATIONS / INSTALLATIONS IN PROCESS (MAY 2010)	INTERNATIONAL LOANS OR GRANTS
	PLANNED	ACTUAL			
Phase 1	1999-2005	1999-2008	• Solar Home Systems (SHS) installed in around 65,000 households • Mini-grids based on renewables (Solar PV, small wind turbines, mini-hydro) and diesel for 3,500 households • 1,100 renewable energy systems in public institutions • Installation of pilot wind home systems in 2 communities, serving up to 200 households • Solar thermal systems for water heating, cooking, space heating in public services (ii)	• 6,060 solar residential users • 1,615 wind residential users • 2,277 mini-grid users • 1,449 solar PV installations in schools • 344 public services with solar/ renewable energy systems • 272 solar thermal systems in public services (esp. schools)	US$30 million World Bank loan, plus US$10 million GEF Grant
Phase 1 Extension	2009-2011	N/A	• 15,500 solar home systems • 21 mini grids serving up to 2,500 households • 140 solar-thermal systems • 630 solar PV systems for rural schools and public services • 20 solar powered water pumps • 2 biomass generation projects	At the time of research, the projects were all in procurement phase.	US$50 million World Bank loan
Phase 2	Unknown	N/A	• Unspecified at present; however, informal PERMER estimates put the number of potential unserved residential users at around 30-40,000	N/A	Estimated World Bank loan request: US$200 million

Notes
(i) The targets are the maximum ceiling on installations set out in the loan agreement with the World Bank.

(ii) A 2004 amendment to the World Bank loan agreement permitted financing of solar thermal systems, although without a numerical target set (World Bank, personal communication).

(iii) The figures for solar residential, schools, public services and solar thermal include both certified and functioning installations, and those in process of being installed. The figures for certified, functioning installations in May 2010 were: solar residential (4,360); schools (1,377); public services (193); solar thermal (187). The figures in the table for wind residential users and for mini-grids are for certified and functioning installations. The vast majority of users for mini-grids are residential users, rather than public services.

Sources for data
World Bank (1999); World Bank (2008); PERMER (May 2010) 'Sistemas Instalados, en Instalación y Bajo Licitación (previsto), por Provincia'; and interviews with PERMER staff.

3.1 Objective of PERMER

The objective of PERMER is to provide electricity to low-income rural communities, beyond the reach of the conventional grid, in particular through renewable energy technologies.

It was originally conceived that, within five years of the programme's initiation, there would be up to 65,000 households served by solar home systems and 3,500 households served by mini-grids, based on renewable sources, diesel or hybrid technologies (World Bank, 1999). This was out of an estimated total of 250,000 households without electricity access (interview, PERMER staff). In addition, the programme aimed to provide electricity for up to 1,100 rural schools, health dispensaries, police stations and other public buildings. The targets on users to be served have changed over time in accordance with the rising cost of solar panels, the slower-than-expected rate of progress, better information about market size, and as part of a 2008 loan extension agreement (see Table 1 on pages 16-17).

The World Bank project design documents show that, as a result of the new electricity services provided, it was expected that PERMER could bring about a range of benefits, including improved quality of life, better education, improved productivity and economic opportunities, for instance through local supply of energy equipment (World Bank, 1999). These benefits appear more aspirational rather than being core programme objectives, against which PERMER's success would be evaluated (See section 3.6 on Monitoring and Evaluation).

3.2 Key features of the delivery mode

Box 1
Key Features of PERMER delivery model

- a top-down, federal government-led programme, delivered in partnership with provincial authorities, with the latter responsible for execution and regulation
- use of market concession contracts to deliver rural electricity services, with the service performance overseen and contracts enforced by a provincial regulator
- emphasis on private sector participation and delivery, in particular through supplying equipment and managing service contracts for maintenance
- flexibility in the type of service operator involved, to include private companies, co-operatives or state companies
- equipment is owned by the concessionaire who is responsible for maintenance, instead of the user
- majority financing from international loans, national and provincial budgets, with small-user contributions
- heavy subsidies for installation and user tariffs, which vary according to local conditions (such as costs, residents' capacity and willingness to pay, existing local tariff structures)
- focus on the use of renewable energy, but neutral on individual technologies and inclusive of fossil fuel generation (e.g. hybrid diesel-solar mini-grid), with choices made on the basis of technical and best value options
- voluntary opt-in, with provincial governments deciding whether to participate in the programme and individual consumers deciding whether to purchase the service offered
- community participation focused on information provision, tariff payment and connection or maintenance requests, with fuller consultation for higher impact projects, such as mini-grids or those involving indigenous groups
- the majority of generating equipment is imported from outside Argentina, in particular for solar PV, with local contractors managing installation
- capacity building for provincial governments and regulators so they are equipped to design and implement projects, and regulate concessionaires
- Regular monitoring of technical outputs in order to meet donor accountability needs, with one deeper socio-economic impact evaluation

3.2 Rationale and evolution of private sector focused model

The choice of delivery model was in a large part influenced by the privatisation process, as well as other factors around the need for equipment to be well maintained and for demands on users to be minimised. It is important to note that aspects of the model have changed over time, principally in terms of downscaling the role of the private sector. These changes involved extensive renegotiation of loan terms with the World Bank. The evolution of the model and rationale for choices made are discussed below. (See Annex B for a summary of the four major amendments to World Bank loans, 1999–2008.)

The original model envisaged that provinces would use exclusively private sector concessionaires, who would be responsible for procuring, installing and maintaining generating equipment, with financial support from PERMER and the provincial government in the form of installation and tariff subsidies. Concessionaires were also expected to contribute to capital investments, recovering these through a connection charge and the tariff.

This private concession-based model was the first of its kind in terms of World Bank financing for rural electricity markets. Given that the privatisation process was still in process, it was anticipated that in some instances PERMER would work with the existing concessionaire who had rights to urban and rural markets, and in other cases a new rural concession would have to be bid out, with contracts awarded on the basis of the lowest subsidy proposal. Part of the PERMER funds were aimed at helping provincial governments strengthen their regulatory framework and institutions, in order to run bid processes and supervise concessionaires' performance (World Bank, 1999; Covarrubias and Reiche, 2000).

The main reason for choosing this private concession approach appears to be that it was consistent with the reform process under way and with the broader ideological drive for private sector-led approaches, promoted by the Menem government and by institutions like the World Bank. Indeed, the World Bank had already been providing technical support for the electricity sector privatisation. In its initial project loan document, the Bank describes the aims of PERMER as to 'develop a sustainable electricity market in dispersed rural areas, served and financed by private concessionaires, using renewable resources and environmentally clean technologies, wherever feasible' and highlights that one activity of the project included 'the consolidation of power sector reforms in the country' (World Bank, 1999, pages 3 and 5).

It is worth noting that, although another type of private sector approach based on individual private dealerships was considered, it does not appear that the PERMER programme involved a systematic cost-benefit analysis of the full range of possible approaches, including alternative options such as an exclusively government-run programme.

Beyond the priority given to the private sector, two other underlying restrictions seem to have been important in defining the design of the PERMER programme. The first was that the burden on users should be kept to a minimum. This was driven by perceptions about limitations in people's financial resources, and technical or management skills. The second was that programme sustainability would depend on having an effective system for maintenance. This emphasis on maintenance was based on observation of other programmes that had purchased and installed equipment only to find that users were unable to pay for maintenance (e.g. replacing fuses, batteries, cleaning), resulting in the equipment falling into disuse. These two factors together helped guide the choice of solar PV panels as the main generating equipment (at least in areas of high solar irradiation), since the panels require little maintenance or daily user management. They also favoured the contracting of a maintenance provider, funded by a tariff, rather than having users own the panels themselves and be responsible for repairs (interview, PERMER staff).

Over time, the design of the delivery model, with its exclusive focus on private sector concessions and requirement for their co-financing, proved to be a key block to implementation. The first reason for this was that the power sector reform process was never completed, or even initiated, in some provinces. As such, PERMER could not make progress in those provinces that had not privatised their distribution services, since these were ineligible for funding under the World Bank loan terms. Second, companies' requirements to make a return on their capital investments meant they were demanding increases in user tariffs, which the provinces could not afford since they

Primary school students playing football, Inticancha, Jujuy.

provided the subsidies for these tariffs. This problem was directly linked to the 2001 crisis and currency devaluation, which meant on one hand that the cost of imported solar panels and other equipment rose sharply, as did concessionaires' own costs, while on the other, rising poverty meant provinces were increasingly cash-strapped and were diverting previously ring-fenced electricity sector subsidies for other pressing social needs.

To cope with these challenges, the model of PERMER was changed to allow:

- Greater flexibility in service providers, so non-private sector entities, including state-run companies and co-operatives, could install and maintain services in public institutions and households (agreed in 2004 for schools, and 2005 for households)
- The ending of requirements for private sector concessionaires to contribute to procurement and installation costs, with PERMER instead funding all capital costs (agreed in 2007)

3.3 Institutional roles and relationships

The main institutions involved in delivering PERMER are:

- Federal Secretariat of Energy (which is part of the Ministry of Infrastructure, Federal Planning and Services)
- Federal Ministry of Education
- Provincial government and provincial energy ministry
- Provincial public service regulators
- Concessionaires (private or public companies, or co-operatives)
- Local contractors
- Users (residents, public service buildings).

At the national level, the central coordination, oversight and support functions are delivered by a PERMER team (the UCP), located in the Secretariat of Energy, while the provincial governments, which have their own executing unit of PERMER (UEPs), are responsible for delivery. Key responsibilities of the provincial administrations include:

- commissioning market and technical surveys to identify the overall level of demand, people's willingness to pay and technology options
- deciding what installations to propose for funding
- regulating the service providers, and
- ensuring that installations meet the necessary technical, social and environmental standards.

Another key actor is the Federal Ministry of Education which, as well as providing financing, has a complementary programme, PROMER (El Proyecto de Mejoramiento de la Educación Rural – Project for Improving Rural Education), which provides the electrical appliances that schools can use after installations are completed, such as computers, TVs and radios. Annex C provides a complete overview of the key institutions and their functions.

There are a whole series of steps involved in implementing PERMER within a province, the first of which is the establishment of framework agreements between the nation and provinces, and with concessionaires, which set out the commitments of each party. This is preceded by a significant outreach effort by the UCP towards provincial governments in order to explain and market the programme, and encourage them to participate. There has also been significant capacity building with provincial government staff and the regulator. When it comes to specific installations, the basic project life cycle involves three phases, which are set out in Annex D.

"PERMER is a public-private partnership, led by the federal government and implemented by provincial authorities, and involving private sector firms, co-operatives and state companies"

3.4 Financial model of PERMER

PERMER is typical of many rural electrification projects in that it involves a high level of public investment and subsidies. The majority of financing in its first phase has come from World Bank loans and a GEF grant, with co-financing from national and provincial government budgets, concessionaires and users. The dominance of public sector financing reflects the high cost of serving very dispersed rural populations compared to concentrated, urban markets, as well as the limited resources of many consumers and the consequent difficulty of making it a sustainable, profitable operation for private sector firms.

Capital costs

Table 2 below provides estimates of the size and distribution of costs for Phase 1 of PERMER, which ran from 1999 to 2008. This shows that, of the estimated total project costs of US$58.3 million, US$30 million was covered by a World Bank loan and US$10 million by a GEF grant. Other contributions included around US$2.3 million from the Ministry of Education, US$5.2 million from provincial governments and around US$10 million from concessionaires and users combined. These costs cover all aspects of initial project development and capital expenditure (project design, capacity building, market surveys, equipment procurement and installation etc) but exclude on-going maintenance costs.

The World Bank loan was initially due to be disbursed over six years, from 2000 to 2005. But, in a large part due to the 2001 crisis, Phase 1 of PERMER eventually ran until 2008. In 2008, the World Bank agreed to provide a loan extension of US$50 million to run for three years until 2011 ('Phase 1 – extension'). The Argentine government is currently in the process of developing a request for a further loan from the World Bank of around US$200 million, with which it aims to cover the remaining 30-40,000 potential users that PERMER staff estimate will still lack electricity access ('Phase 2') (interview, PERMER staff).

Table 2
Size and share of PERMER costs, Phase 1, 1999–2008

INSTITUTION	SHARE OF CONTRIBUTIONS (%)	SIZE OF CONTRIBUTION (US$ MILLION)
World Bank and GEF	70	40
Concessionaires and Users	17	10
Provincial Governments (via a National Energy Fund)	9	5.2
Ministry of Education	4	2.3
Total Cost of Phase 1 PERMER (1999–2008)		**58.2 (i)**

Source PERMER
Note
(i) PERMER data provide the total estimated spend (US$58.2), the estimated share of contributions and the size of World Bank/GEF loans/grants. The discrepancy between the total cost, and the sum of the individual contributions, is due to rounding up/down by PERMER.

The exact distribution and source financing varies depending on the type of installation and user, and whether it refers to the initial investment or ongoing operational costs.

In the case of school installations, which represent the largest public services component, there is an 80:20 split in capital investments. That is to say, 80 per cent of equipment procurement and installation costs are covered by PERMER (i.e. World Bank loan), with the remaining 20 per cent provided by the Federal Ministry of Education. The monthly tariffs for service and maintenance are paid for by the provincial Ministry of Education. For other public services, PERMER also funds 80 per cent of capital costs, with the remaining 20 per cent covered by provincial governments.

In the case of users with individual solar home systems, the capital costs were originally spread between PERMER (70 per cent), the province (9 per cent), the concessionaire (19 per cent) and users (2 per cent). The concessionaire's capital investments were due to be recovered through a tariff and connection fee, spread over a 15-year period. As already mentioned, this has changed so that the investment costs required by the concessionaire were first reduced and then ended in 2007, with PERMER funds now covering these fully. Table 3 below provides a breakdown of the estimated relative contribution of different institutions to project development and installation costs during Phase 1 of PERMER.

Table 3
Share of capital costs by finance source and type of installation (Phase 1)

FINANCE SOURCE	INSTALLATION TYPE		
	RESIDENTIAL SHS (% share)	MINI-GRID (% share)	SCHOOLS (% share)
World Bank	70	75	80
GEF			
Ministry of Education			20
Provinces (via National Energy Funds or Other Budgets)	9	14	
Concessionaire	19	10	
User	2	1	
Total	**100**	**100**	**100**

Source PERMER

Maintenance costs and user tariffs
The cost of maintaining and replacing equipment (at the end of its lifetime) is covered by a tariff, charged and collected from users by the concessionaire, and supported by a subsidy. In the case of individual home systems, the tariff is usually a flat rate aligned to the capacity of the equipment, while connections to a mini-grid, which has higher capacity, involve a combined flat and variable rate, depending on use. The tariff is set by the provincial regulator, through a process of negotiation with the concessionaire. Public hearings are held as part of the process to enable residents to provide their own comments. After being frozen for several years after the economic crisis, many provincial governments have, or are in the process of, raising residential tariffs.

The tariffs are heavily subsidised by provincial governments, with the level of subsidy varying between provinces. For instance, one PERMER staff member commented that, while in Jujuy subsidies cover up to 90 per cent of the user tariff, in parts of the province of Chaco the tariff is virtually unsubsidised. At the end of 2010, the average tariff subsidy rate was 76 per cent, with the users paying an average of AR$16,99 per month (US$4) These are close to the rates envisaged in the 2008 World Bank loan extension, which aimed for an average tariff subsidy rate of 70 per cent, with users paying around AR$10 per month (US$3) (World Bank, 2008).

The provinces' subsidy contribution to tariffs and installations comes out of their receipts from a national fund for electric power, the FNEE (Fondo Nacional de la Energía Eléctrica), which itself is raised from a tax on petrol and on electricity sales in the wholesale market. The FNEE has two key sub-funds, which the provinces use for PERMER, one of which is earmarked for subsidising user tariffs (FCT) and the other (FEDEI) supports investments for power sector generation and transmission, particularly in rural areas.

A number of factors shape the level of tariff and subsidy set by provincial governments. A key criterion is that users should pay the same or less than existing energy sources (kerosene lamps, candles, animal fat, etc). This is assessed through market surveys, conducted by PERMER, which identify the potential level of demand, people's existing expenditure (sometimes referred to as 'capacity to pay') and their stated willingness to pay for the service at different levels of power capacity. The surveys are considered important for understanding the market and setting tariff levels. For instance, in Tucuman, which is a small province with a high population concentration and an extensive grid network, the concessionaire initially said there was no dispersed market to serve. However, the PERMER market study eventually revealed 5,000 potential users with capacity to pay of around 10 pesos for a 100 Wp/day system, an assessment that has apparently been used to set tariff rates (interview, PERMER).

Provincial laws, and local political dynamics, also play a role in determining tariff and subsidy structures. For instance, in Jujuy, existing local rules on tariffs for low-income dispersed rural users meant the findings on willingness or capacity to pay had limited impact on fees charged to residents with PERMER-funded installations.

3.5 Community participation

PERMER is a largely top-down, technically driven programme, centred on increasing connections to a pre determined service, with community participation focused on awareness-raising to build customer demand, on managing any social or environmental risks, and meeting World Bank consultation requirements.

Information and awareness-raising
For PERMER, the main aspect of community participation is awareness-raising and information provision by PERMER to local communities through community meetings and workshops. This process is seen as vital to the success of a project and has a number of purposes. One is to ensure residents can understand what the service is and decide (as individuals) whether they want to request a connection, and at what level of power. Another is to manage expectations about the service and how it works. For instance, users need to understand – and have realistic expectations about – when connections may occur, the level of power provided, and how to avoid service interruptions (PERMER, 2008).

The perception of PERMER staff is that, for an individual home system like a solar panel or wind turbine, this level of involvement is sufficient since the technology is non-disruptive and does not require community coordination for delivery. PERMER staff also pointed out that the programme has deliberately avoided certain channels of participation in order to avoid being captured by political interests. This included formal consultation processes with some types of official community representatives, on the grounds that these individuals often live in towns, have little contact with the community and have, in some cases, sought to subvert development programmes for their own personal gain.

Communities are not involved in making decisions about the choice of technology or equipment, which are defined on the basis of technical assessments and international standards. One insight offered by the NGO Fundación EcoAndina, which has worked for many years on renewable technologies in Jujuy, is that – at least in the early years of their work – the lack of experience or knowledge of communities on renewable energy would have made it very challenging for them to make decisions about what technologies to adopt (see section 6.3).

At the same time, it is worth noting that there is community involvement in upstream technology development initiatives (i.e. prior to PERMER's engagement). Fundación EcoAndina and the technical institute, INENCO, at the University of Salta, are two examples of this. Their work does not focus on solar home systems – since the technology is standard and local industry cannot compete against cheap Chinese models – but other applications, such as solar cookers, water heaters, home ventilation/heating systems, or solar dryers of agricultural products. Their work involves communities in testing and supporting the development of local enterprises to manufacture the equipment. In the case of solar cookers and water heaters, PERMER has started to procure and install these as part of its programme (see sections 5 and 6).

Consultation to manage social risks
In general, PERMER is conceived as a low-impact programme, with risks often limited to issues of consumer over expectation, theft, storage of fuel or the disposal of batteries. Community involvement is more extensive where the social and environmental risks are higher, in particular where a mini-grid is constructed or where indigenous groups are involved (see PERMER manual on managing environmental and social risks, PERMER, 2008).

In the case of mini-grids, which involve more extensive construction works, communities play an active role in deciding whether and where it should be built, in order to minimise local disruption. In the case of indigenous communities, the World Bank requires PERMER to meet its safeguard policies and ensure these communities give free, prior and informed consent before a project like

a mini-grid goes ahead. This involves consultation and diffusion through national or local representative bodies, with written confirmation of consent.

This requirement for an indigenous people's plan was introduced recently as a condition of the World Bank' s 2008 loan extension, so operational experience to date is quite limited. PERMER staff felt that having these guidelines could help improve consultation practices for all communities involved in the programme. However, one of the challenges is that, compared to other Latin American countries, the indigenous population in Argentina is small: just 2.8 per cent of households include at least one person who defines themself as indigenous, or of indigenous descent (PERMER, 2008). According to PERMER staff interviewed, these populations do not always live as separate communities, or follow specific representational, linguistic or cultural practices as would be common in neighbouring countries with greater numbers of indigenous people, like Bolivia, for example. They pointed out this could create situations where consultation requirements are onerous or inappropriate. For instance, in a 'mixed' community, it may be inappropriate to give special rights of consent to one group only, or there may be no local representative body available to provide consent – passing this up to a distant, national forum without local connections.

"Community involvement varies from basic information provision to more participatory decision-making"

3.6 Monitoring and evaluation (M&E)

PERMER has a fairly well-developed monitoring system. Monitoring is principally focused on technical outputs, although PERMER has also done one deeper evaluation exercise, which covers a number of social and economic outcomes for users. In general, M&E seems to be driven by requirements from the World Bank, together with the Argentine government's own audit procedures.

In terms of ongoing technical monitoring, PERMER provides quarterly reports to the World Bank on a set of indicators, which are directly tied to the Bank´s own project lending goals. These indicators have been refined in light of experience. The broad areas covered are set out in Table 4, with a fuller breakdown provided in Annex E.

A detailed, mid-term assessment was undertaken for PERMER by external consultants in 2005-2006, also at the request of the World Bank. This was a fairly extensive exercise, involving survey work, user interviews and focus groups, to assess the operation and use installations in households and schools in communities in three north-western provinces where PERMER´s implementation was more advanced (Salta, Tucuman, Jujuy). The scope of data gathered covered aspects such as:

- what the electricity was used for
- user satisfaction (technical quality, maintenance service)
- user knowledge (complaints system)
- changes in income or economic activities attributable to electrification
- the effect on people's hours of social or cultural activities
- changes in household size (to assess migration patterns)
- school retention and absenteeism
- pedagogical methods
- educational performance

The study also presented a model and detailed guidelines for monitoring and evaluating PERMER (see Annex F for more details of indicator areas proposed). So far, PERMER has not repeated the exercise and staff consulted were not aware of immediate plans to do so in the short term. With the new phase of PERMER – which will involve more provinces, a greater variety in socio-economic and geographic conditions, and technologies used – there appears to be a real need and opportunity for more evaluation work, which is focused on outcomes rather than outputs. The guidelines provided, the results of the 2006 evaluation and other baseline information gathered in market surveys, mean that PERMER already has many tools to do longitudinal, quantitative and qualitative assessment of the outcomes of installations. Some areas that could be considered include:

- Implementation/impacts between provinces with different socio-economic, geographic or institutional characteristics
- Implementation/impacts by type of operator (public or private concessionaire, or co-operative)
- Implementation/impacts by renewable energy source, purpose and equipment (illumination, water pumping, cooking/heating; individual systems, mini-grids)
- Impacts by population characteristics (gender, age, ethnic group)
- Deeper, qualitative analysis of institutional performance (provincial government, regulator, concessionaire).

Table 4
Outputs and Indicators reported by PERMER to World Bank

LOAN OBJECTIVE/OUTPUT	INDICATOR TYPE (NON-EXHAUSTIVE EXAMPLES)
1 Increase access to electricity services and quality of associated uses for rural populations	• Number of installations in households and public services • Number of households served by mini-grids
2 Increase private sector participation in the off-grid rural electricity market	• Number of operators and number of private sector concessionaires operating under PERMER
3 Number of systems for public services operated by private concessionaires	• Average tariff subsidy for residential systems (%) • Average monthly retail tariff for households
4 Increase renewable energy use and reduce CO^2 emissions	• Avoided CO^2 emissions (tons CO^2eq) • Total installed capacity (KW)
5 Strengthen regulatory framework associated with off-grid regulatory framework	• Percentage of certifications of installed systems • Percentage of complaints attended without subsequent complaint.

“Solar systems have enabled more time in the evening for studying and preparing classes”

Primary school students outside Marcelo G Marquez school, Inticancha, Jujuy.

4
Operation and impacts: national overview

This section summarises the state of progress and impact at the national level, and the barriers and challenges to implementation. The social impacts are discussed briefly here, and will be explored in more depth in the section on Jujuy. It emphasises that:

- PERMER has successfully delivered basic electricity access to residents and public services who would not be reached under a 'business as usual' scenario
- For residential users, solar home systems (SHS) have improved their daily living, for instance, by extending the hours available for work, study or domestic activities, by providing a better quality of illumination, and the opportunity to listen to the news or music
- The impacts in schools are often seen as more significant than at the household level. Solar systems have enabled more time in the evenings for studying and preparing classes, more diversity in teaching methods, better knowledge of, and preparation for, the 'outside world'
- The main limitation of the solar systems funded by PERMER is the low level of power provided, which is not sufficient for the scale of domestic, educational and productive needs
- PERMER has faced a range of economic, institutional, geographical and capacity barriers, which have slowed progress and limited impacts.

4.1 Extending electricity access to schools and households

The PERMER programme has had many positive impacts. Its main achievement is in the number of installations attained, and the basic illumination and social communication this provides for households and public services. It is widely agreed that, without PERMER funding, neither power providers nor provincial governments could have made much progress, especially given the context of the 2001 crisis and market liberalisation. By May 2010, PERMER had achieved solar PV installations in 1,377 schools, across 12 provinces, and was in the process of installing 72 more systems. Education Ministry officials estimate that current and planned installations (including under the Phase 1 loan extension period) will mean that PERMER covers around 80 per cent of schools needing electricity access nationwide. Typical installations average at between 600–800 Wp, with converters allowing the use of appliances at 220 V with an alternating current.

Among residential users, by the same date, PERMER had already installed SHS for 4,360 residents, across four provinces, and a further 1,700 systems were in the process of being installed. In addition, over 1,600 residents across two communities in the province of Chubut had mini-wind systems installed, and over 2,200 households were connected to mini-grid systems (see Table 1 for details). The majority of SHS for households are 100 Wp/12V systems, while mini-grids provide between 8 and 24 hours/day electricity at 220V, which is similar to the level of service provided by the national grid. Table 5 below provides a breakdown of the average costs and capacities of solar systems installed in households and schools.

Table 5
Implementation of PERMER in schools and households during Phase 1

USER TYPE	SCHOOLS WITH SOLAR SYSTEMS	HOUSEHOLDS WITH INDIVIDUAL SOLAR SYSTEMS
Number of installations / installations in process	1,449	6,060
Average potential of solar PV system installed	600–800 Wp	100 Wp
Average cost of solar PV installation (US$) (i)	US$18,000	1,800
Typical capacity/usage of average system	• 10 lights per school used for 4 hours a day • 1–2 hours of radio per day • More occasional (e.g. weekly) use of personal computer, TV or video (ii)	• 2 lamps (15 watts) for 4 hours a day • Radio (10 watts) for 3 hours a day • Black and white TV (80 watts, 1 hour a day (iii)
Number of installations of solar cookers and/or water heaters/installations in process (schools only)	272	N/A

Notes

(i) Costs vary significantly according to local conditions, such as the topography and ease of access. Cost estimates cover all aspects of installation, including equipment purchase, batteries, logistical costs, internal wiring, certification and so on. The figures are based on an average of $US30 per 1Wp for an average school installation of 600 Wp, and $US18 per 1Wp for residential installations of 100Wp. School installations have higher unit costs because, for instance, they operate on 220V and on alternating current, which requires a transformer. Residential systems operate at 12V and on direct current.

(ii) These figures are drawn from PERMER, 2006 and are based on assessments of usage in Tucuman and Salta, where systems were between 500-600 Wp, which is lower than the average size PERMER now installs. There were differences in usage between the two provinces: schools in Salta reported greater usage, with an average of 34 lamps per day used for 3 hours. The occasional usage of bigger equipment, such as PCs, reflects class planning and logistics (PCs are sometimes kept in nearby houses to avoid theft).

(iii) This data is from Covarrubias and Reiche, 2000 and reflects estimated capacity of the systems (i.e. before installation).

Sources

PERMER (May 2010) 'Sistemas Instalados, en Instalación y Bajo Licitación (previsto), por Provincia'; interviews with PERMER staff: PERMER (2006); Covarrubias and Reiche (2000).

The majority of Argentina's 23 provinces are now involved with PERMER, although with considerable variation in the degree of implementation. Progress is most advanced in the north, in provinces such as Jujuy, Salta, Tucuman and Chaco. In some provinces, such as Catamarca or Santiago del Estero, barriers such as a lack of interest from the incumbent concessionaire, has meant that the programme has focused primarily on schools, rather than users, since the former could bypass the concessionaire and be served by state organisations alone.

4.2 Positive impacts of PERMER installations

Residential users

The perception of programme staff, supported by user surveys, is that residential access to solar power has improved people's daily living, principally by extending the active day through better quality illumination, which is also more convenient and cheaper, and by increasing knowledge of the world beyond the local community through radio usage. Some people report using the lighting to read, study or do artisanal work – all without straining their eyes as before – or having more family or social meetings. Safety issues, such as using lighting to see whether there are dangerous insects in the room at night, were also mentioned. These improvements to quality of life are significant, and user surveys showed the majority of people were broadly in favour of, or positive about, the service. However, these changes should be seen as incremental rather than transformative, since the level of delivered power provides only for a few hours of lighting in the evening plus the ability to listen to the radio

Schools

Solar installations in schools are seen as having more impact than household installations because of the higher level of power provided, the types of appliances that can be used, and the educational benefits these bring for young people.

These impacts are examined in a 2006 PERMER evaluation on schools in Tucuman and Salta, which found generally high satisfaction levels from teachers, with perceptions of improved staff and student performance, in particular by allowing more evening study and class preparation, and the greater use of technology, like radio-recorders, TVs and PCs. Some of those surveyed described the service as a significant life change, with impacts particularly strong in those schools where the teacher and/or students sleep overnight. Familiarity with modern technology, in particular through being able to use a computer, as well as more contact and understanding of the outside world and urban life, by watching videos, hearing different accents and listening to the news, are frequently mentioned by teachers and PERMER stakeholders as important benefits. Class planning is made easier where teachers can print and photocopy handouts. For schools with water heaters, access to hot water for showers for boarding students is seen as a real quality of life improvement. There have also been positive spillover effects in the community, as schools are increasingly being used as a focal point by residents e.g. for charging mobile phones, and for social gatherings.

Other, more general positive impacts of PERMER cited by interviewees, include good performance on maintenance contracts by concessionaires in some – but not all – provinces. This seems to be supported by monitoring data provided by provincial regulators, which show that, on average, the share of user complaints made to concessionaires without a follow-up complaint is currently 91 per cent, which is in line with World Bank targets (of 90 per cent). In addition to maintenance, some interviewees highlighted the innovation and expansion of the programme's remit for future phases as a positive impact. For instance, to include mini-grids, repowering of existing systems, and solar devices for cooking and water heating in schools.

4.3 Limitations and barriers to implementation

There have also been also criticisms of PERMER, in terms of the outcomes achieved. The two main ones highlighted by PERMER staff and stakeholders are that:

- the rate of progress had been very slow and the number of installations achieved much fewer than anticipated – while costs are high
- the equipment only provides minimal lighting/power needs, at a rate far lower than that enjoyed by urban counterparts, and does not address the full range of energy needs
- the basic level of power provided is not enough to create new economic opportunities, have a significant impact on poverty or address migration out of rural areas.

Other limitations are that:

- sometimes the equipment does not function properly, due to poor maintenance by concessionaires, incorrect use by users (e.g. using car lights instead of low-energy bulbs) or insufficient understanding by users of their rights or the complaints system
- usage is limited by the lack of appropriate appliances available for low voltage systems
- PERMER has not managed to stimulate a local industry or jobs in the renewable energy sector
- the private sector concessionaire model is overcomplicated and has created high administrative and transaction costs

Solar water heater, school in Quirquincho, Jujuy.

There are a variety of economic, institutional, geographical and capacity issues that lie behind these challenges. Some of the key factors, a number of which have already been highlighted in the preceding discussion, are set out below.

- **Economic constraints.** The 2001–2003 financial and economic crises were a major cause of delays. Currency devaluation meant the cost of importing solar panels soared, immediately reducing the amount of equipment that could be purchased. On top of this, austerity measures led to sweeping cuts in federal and provincial budget allocations for the project and the subsidies, and there was a reduction in key staff in the Secretariat of Energy and in the Project Coordination Unit (UCP). Although the economy is in a better state now, lack of provincial funds continues to be a key barrier to the programme's expansion.
- **Limitations of objectives and delivery model design.** The rigidity of the original model, and excessive expectations vis-à-vis the private sector and reform process, were clearly major barriers to implementation, together with the protracted process for negotiating amendments to the loan agreements with the World Bank. Added to this is the fact that, from the outset, the programme focused only on the most basic level of power provision.
- **Role of provincial governments.** The federal system makes provincial administrations responsible for energy services, but these often lack resources and capacity to take forward any initiative in this field. In some instances, a lack of a positive attitude towards, or interest in, rural populations on the part of the provincial government has been a problem. Some interviewees suggested that, politically, rural populations are not seen as important as they provide relatively few votes at election time, or because elections are more likely to be won on grid extensions (rather than a programme like PERMER).

Señora Nilda standing outside her house near Cara Cara. The solar panel had been installed two weeks previously and powers two lights, which provide a better quality of illumination than candles.

- **Capacity constraints – government, province, contractor and user.** Knowledge of renewable energy systems is frequently cited as one of the most significant challenges in programme implementation. This is particularly the case in the early years of the programme, when renewable energy was new for all involved. Some of the consequences of inadequate experience included:
- Under estimation of the long lead-in times and overambitious targets on installations
- Procurement failures, as agreed contracts fell through due to the long gap between the initial contract award and the province being ready to start installations
- Incorrect installations due to a lack of locally qualified contractors
- Overuse of equipment by residents (e.g. to charge a car battery), leading to power outages.
- **Adapting to geographical context.** The physical distance and isolation of users makes logistics difficult to organise and extremely costly. International contractors responsible for equipment supply and installation, who often did not have a staff member on the ground, sometimes under-estimated the costs and logistical organisation involved, leading to delays or sometimes to the contracts being rescinded.
- **Corporate attitude.** The attitude of firms has played a determining role in the rate of progress. For instance, in one province, the concessionaire has not been willing to serve rural markets, but at the same time it has stalled on requests to give up its exclusive rights to the province, creating legal blocks to rolling out PERMER with residents.
- **Procurement processes.** Aligning provincial procurement processes with World Bank strictures has been a significant institutional challenge. Also, World Bank rules that tenders over US$500,000 have to be opened to international bidders, together with stringent technical and administrative requirements, are cited as one factor that has precluded opportunities for promoting local equipment manufacturing.
- **Lack of integration with rural development plans.** PERMER has been largely executed as a stand-alone programme of the Secretariat of Energy, which limits the possibilities for having a real impact on poverty, economic opportunities or rural migration to the towns. Addressing these would require PERMER to be integrated into a broader set of bundled policies and programmes for rural development, co-ordinated across all key ministries, provincial or local players.
- **Lack of local equipment and appliance manufacture.** Argentina does not have a local market in low voltage appliances, as can be found in Bolivia or Paraguay, possibly because the high rate of grid connections means there is insufficient market demand. And while there is production of some local components and the assembly of generating equipment, particularly lower-tech equipment such as solar water heaters, this is generally on a small scale and cannot compete for PERMER contracts with many foreign suppliers. Competing with low-cost Chinese suppliers on solar PV production is nearly impossible, given that there is no domestic cell industry. While PERMER can create market demand, the creation of a local equipment supply industry depends on the government introducing broader incentive policies and programmes.

5
PERMER in Jujuy: context, operation and state of implementation

Having reviewed the operation of PERMER at the national level, the remainder of this study focuses on how PERMER has operated in Jujuy. This section describes the economic and social conditions of Jujuy and the structure, operation and state of implementation of the PERMER programme. The key points to note are:

- The economic, social and climactic conditions in Jujuy – particularly in la Puna – are very harsh and increasing energy access is vital to address poverty and create economic opportunities.
- PERMER´s success in installing and maintaining residential installations in Jujuy owes a lot to its distinct market structure and contract arrangements, the capacity of its provincial government and regulator, and the approach and attitude of the concessionaire.
- Economic sustainability remains a challenge, since the rural market is not profitable and subsidies are high.
- Innovations, such as ´PERMER calórico´, which installs solar cooking and heating devices, highlight PERMER´s potential to address a broader range of energy and development needs.

5. 1 Economic and social context

Jujuy is one of the most isolated and poorest provinces in Argentina. Bordering Bolivia and Chile in the north-west, Jujuy consists of four broad landscapes and micro-climates. These range from the desert plateau of La Puna and the mountain range of La Quebrada to the sub-tropical jungle region of El Ramal and the temperate, populated zone of El Valle (the maps in Annex G identify the four different zones of Jujuy and location of the fieldwork).

La Puna, which is where fieldwork was conducted, is an arid plateau around 3,500 metres above sea level, surrounded by mountains. It has a very dry climate, with high daily temperatures and low rainfall (400mm or less per annum). At night and in winter temperatures drop sharply, sometimes falling several degrees below freezing even inside people's homes. Population density is low, with just 7 per cent of the province's population living in La Puna.

In La Puna, the main economic activities are the herding of llama, sheep and goats (for meat and wool), smallholder agricultural production (e.g. potatoes, beans, peas, onions, garlic), and handicrafts. Much of the livestock and agricultural production is for self-sufficiency, with the excess sold in local or regional markets. Soil quality is poor and the area faces an ongoing process of desertification. The low rainfall and lack of infrastructure for wells and water pumping means there is a severe lack of water for human and animal consumption, and for irrigation. Land ownership has typically been tenuous. However, this situation is improving as a sustained local campaign has meant that in the last few years a significant amount of land has been titled to communities. In these situations, land title is held in common, with communities recognising among themselves the different parcels used by families.

It is hard to find reliable socio-economic data for Jujuy, particularly in terms of rural poverty. According to a recent UNDP Argentina report, Jujuy is ranked 16 out of Argentina´s 24 provinces in terms of its human development (PNUD, 2009). And poverty rates have fallen considerably since the years of economic crisis: in the second quarter of 2009, 17.3 per cent of people in urban agglomerations in Jujuy were living below the poverty line, compared to over 70 per cent at the end of 2002. Jujuy's current poverty rates are higher than national average (13.2 per cent), but lower than for some north-eastern provinces (Corrientes, Formosa, Gran Resistencia, Posadas).

PERMER´s 2006 evaluation gives a clearer idea of the situation of rural households. A survey of 100 residents using solar panels across Jujuy estimated an average household income of 350 pesos per month per family (around US$120). This came from a variety of sources, including sale of wool, handicrafts, textiles, and sometimes animals, as well as support from family members who had migrated, and from the government, with over half of families receiving 150 pesos per month via the 'Head of Household Subsidy'. The study also found that over half of adults surveyed were not involved in any productive activity, and 90 per cent of this population had either only been educated to primary school level or lower (e.g. through non-attendance or non-completion (PERMER, 2006).

The harsh conditions, and the lack of resources and economic opportunities, have contributed to a very notable process of depopulation in rural Jujuy. Young people in particular often migrate to towns and cities in the province or others in search of jobs and urban amenities. In one village visited, the local headmaster commented that the population had dropped by more than half, from 200 to 90, over the last two decades. Other parts of Jujuy are wealthier, with more economic opportunities. For instance, El Valle, as well as having the main population and urban centres, has extensive tobacco plantations and farming, while in La Ramal, where there is significant production of citrus, tomatoes, peppers, as well as cattle herding. Mining (salt, borax and gold), forestry and tourism industries are other key economic sectors in the province.

Increasing energy access and applications could make a real difference to economic development in rural Jujuy. For instance, a study of productive uses of energy commissioned by PERMER in 2003 highlighted the pressing need for energy to enable water extraction for irrigation of plots, and for animal and human consumption. Other priorities highlighted included functions such as heating in greenhouses; refrigeration of meat products for sale; heating for animal breeding and hatcheries; sawmills for the forestry sector; milling and grinding of salt and borax; and a range of tools and machinery, such as for electric shearing, yarn spinning, leather tanning and pottery.

Jujuy has among the highest rates of solar irradiation in the country – indeed in the world – reaching up to 7.5 kWj/m^2, ensuring very good conditions for solar PV use (Alazakri and Haslip, 2007). For this reason, institutions working in rural development in Jujuy and neighbouring Salta have been experimenting with solar energy for a number of years (e.g. INENCO, University of Salta, Fundación EcoAndina).

For those without electricity access, the main sources of energy for light are kerosene, candles, animal fat (using a rag as a wick), while batteries are used for radios. The 2006 study on Jujuy found that typical spending for lighting and social communication for those without a panel or grid connection was around 20 pesos a month, the majority of which was spent on batteries and battery charging (e.g. from a car or petrol station) (PERMER, 2006). For cooking, the main sources of fuel are gas canisters or firewood, in particular people burn 'thola', a type of slow growing scrub bush. The excessive use of wood or thola is exacerbating the process of desertification, and, the scarcer firewood becomes, the more costs rise as families have to hire vehicles to go further afield to collect supplies or buy expensive bottled gas. A number of families interviewed said they spent around 80 pesos ($US20) a month

on vehicle hire to collect firewood and/or up to 36 pesos (US$8) a month for bottled gas.

5.2 Market and regulatory structure

The structure of Jujuy's power market is often given as key reason for the progress PERMER has made in the province. In the late 1990s, before PERMER's arrival, the power sector was privatised and three markets were created:

- a 'concentrated' market connected to the national grid, which currently has around 170,000 users;
- an 'isolated' market, which includes users connected to a local grid, based out of La Quiaca on the Bolivian border; and
- a 'dispersed' market, which includes mini-grids (fossil fuels, hydro, hybrid with PV) and individual solar panels.

The concentrated and isolated markets are served by EJESA (Empresa Jujeña de Energía S.A.) and the dispersed market by its spin-off company, EJSEDSA (Empresa Jujeña de Sistemas Energéticos Dispersos S.A.). The two companies have the same owners and investors.

When establishing the new markets in 1996, the provincial administration broke with Federal guidelines on privatisation, which stipulated that tenders for the concentrated market be awarded on the basis of the best price offer and for the dispersed market on the basis of the least subsidy. Concerned that separating the two would result in no bidders for the dispersed market (which was not seen as commercially attractive), the province bundled the tender together, stipulating that anyone competing for the concentrated market had also to bid for the dispersed market, with the tender awarded to the lowest price offer. Critically, the provincial government decided that the contract terms should stipulate that if the company failed in the service it provides to the dispersed market, its contract for the concentrated market would automatically be terminated. The concessionaire's operations are regulated like any private sector company, with the regulator, Su.Se.Pu. (Superintendencia de Servicios Públicos y Otras Concesiones), overseeing its technical performance, commercial operations, maintenance and customer service responses, and imposing fines where commitments are not met.

The contractual linking of the concentrated and dispersed market is considered one of the most important incentives for good performance by EJSEDSA, and is worth comparing with experiences elsewhere. For instance, the province of Salta took a similar approach, with a single contract and break clause, and with two firms owned by the same company serving the distinct markets. In Salta, too, the firms' performance and PERMER progress is considered positive. Meanwhile in La Rioja, where the province held two tenders (as proposed by the Ministry guidelines), the process ended with no company bidding for the dispersed market and so no concessionaire. As a result, PERMER has been unable to make much progress in La Rioja to date (Interviews, PERMER staff).

5.3 State of implementation

Jujuy was the first province to take part in the PERMER programme, starting in 1999, and is considered to be the most successful and advanced in its implementation. To date, installations funded by PERMER in Jujuy amount to:

- solar home systems of 100 Wp for 2,074 individual households (installed and certified)
- 5 mini-grids serving 274 households
- 60 water heaters and solar cookers in schools

These completed installations together account for about half of EJSEDSA's total current customer base of 5,582 (residents and public services), with the majority of the remainder served through diesel, hydro or hybrid diesel-renewable mini-grids. EJSEDSA is currently in the process of overseeing the installation of 1,700 SHS, funded by PERMER, and another 80 water heaters in schools (see Annex H for EJSEDSA map of installations by technology type).

The installations funded by PERMER are close to original estimates from a market survey in 1999. With the latest phase of new installations taking place, the regulators and PERMER staff believe that practically the whole of the dispersed market will be covered, and the future focus of the programme will be on adding power to existing installations and meeting additional energy needs.

5.4 Financial and tariff model

The distribution and structure of financing responsibilities between PERMER, the province and EJSEDSA have changed over time. The original model involved EJSEDSA contributing between 35-40 per cent of the installation costs, with PERMER and the province making up the difference. These were to be recovered via a subsidised AR$600 user connection fee and the tariff, both of which were subsidised up to 90 per cent. However, reflecting the national situation, EJSEDSA's contributions were first reduced and then, in 2008, ended altogether, with PERMER paying all installation costs.

PERMER did undertake a capacity-to-pay survey in Jujuy; however, this had quite limited influence over tariff design because there was already a tariff structure in place prior to PERMER's involvement. These rules stipulate that:

- rural users pay the same price per unit of energy as urban consumers, requiring a subsidy from the provincial government of up to 90 per cent for rural users
- by law, customers in La Puna receive an additional 50 per cent reduction on their tariff ('ley Puna'), reflecting the greater concentration of poverty in the area.

As a result of this tariff structure, a typical customer in La Puna with a 100 Wp panel currently pays around AR$4-6 per month (US$1-1.5). The province pays around

Nurse Yolanda and her daughter outside the Suripujio health post, Jujuy. At the time of this photo, PERMER solar panels installed on the health post were due to be replaced by a grid connection.

AR$800,000 (or US$200,000) per month in tariff subsidies for all its customers in the dispersed market.

The high level of tariff subsidy inevitably raises questions about the sustainability of the model, particularly given the ambition to increase the amount of power for rural users and the likely parallel increase in energy demand in urban areas. This issue was not explored in any detail in the fieldwork. However, in the main, interviewees (government, regulator, concessionaire) repeatedly underlined that the high cost of providing remote communities, and the poverty of users, meant significant subsidies were unavoidable. Government representatives did add that, given the improving economic situation over recent years, the 'ley Puna' may be reviewed to see if this extra subsidy was still appropriate.

5.5 Corporate performance

Economic performance

A key challenge for PERMER is to make the programme economically viable for the concessionaires. The main barrier to this lies in the level of the tariff, together with specific issues such as VAT accounting rules.

The dispersed market in Jujuy is not a profitable business for EJSEDSA, or at least has not been to date. According to EJSEDSA, the firm just breaks even or makes a loss, and staff believe that the need to raise tariff levels is the most pressing issue they face. There are different views on whether the government intends it to be profitable when it sets the tariff. By law, the company should receive an 'acceptable' commercial return, which for the dispersed market is 14 per cent and for the concentrated market around 9 per cent. However, some government staff interviewed suggested that the tariff and subsidy were principally set on a cost-recovery basis. To manage these costs, EJSEDSA shares resources, such as personnel, goods and services, with their profitable sister company, EJESA, which operates in the concentrated market.

An additional challenge to EJSEDSA's sustainability at present is a financial and accounting problem caused by the firm's inability to absorb VAT costs. While the firm pays VAT on the goods and services it procures, it is unable to pass these on because the majority of the tariff is paid out of a subsidy, and only the user portion can return VAT expenses. In the company's view, this is causing a heavy financial loss which, if resolved the company could make a profit. The issue is currently being discussed with the regulator.

Also, although it has a very minimal effect on cash flow, it is worth noting that the concessionaires and regulator both highlighted that, sometimes, customers are unable to pay their bills on time, due to their poverty or remoteness. Since to the firm it is rarely worth the cost of chasing debtors, unpaid bills are allowed to accumulate for several months. Additionally, a very small number of users do not handle money, and pay their tariffs in kind (wool, meat). This flexibility is useful in ensuring the inclusion of some of the poorest and most remote residents.

Technical performance

EJSEDSA's performance on maintenance is considered good by the regulator and PERMER staff. In their view the firm complies with its requirements for annual visits to inspect equipment, it responds to user complaints within the specified time frame – thereby receiving a low level of fines – and is providing adequate guidance to users. EJSEDSA's managing director commented that the rate of complaints/maintenance requests from users has increased in recent years, something he attributes to the greater awareness people have of their consumer rights.

Several reasons are cited by PERMER and the regulator for why EJSEDSA is performing well in its service operations:

- The contract arrangements, which link the dispersed and concentrated markets, create a major economic incentive for strong performance.
- The penalty system, which imposes fines when complaints are not addressed quickly, is effectively enforced.
- Staff capacity, with many of EJSEDSA staff formerly working as employees under the defunct state company, and thus already experienced in serving rural markets through renewable energy
- The positive attitude of the concessionaire towards rural populations. An example of this is the scheme it runs with medical staff at a local university, whereby EJSEDSA staff take doctors with them on their maintenance visits to remote customers, so that they can carry out health check-ups for people usually not covered by regular medical services.
- Use of local people in maintenance operations.

The final point relates to an innovation of the firm whereby, to avoid high logistical costs, EJSEDSA has trained up local people in some of its more remote areas of operation. This is usually a young person educated to secondary school level who is paid to perform basic maintenance tasks. If the problem cannot be resolved easily, that person can call EJSEDSA engineers to seek advice or request a visit. The NGO Fundación EcoAndina sees this as a positive step, not only in ensuring better maintenance service, but also in creating new ´green job´ opportunities in remote areas.

5.6 Challenges and future development

There have been significant barriers and challenges to implementing PERMER in Jujuy. Alongside economic issues, the extreme logistical barriers, limitations in local technical capacity and in users' own understanding and resources are frequently mentioned. For instance, some customers are so remote that they are 1-2 days away from passable roads, and accessed only by foot or donkey. For early installations there were technical problems, for instance in internal wiring, due to local technicians´ lack of familiarity with the equipment. Finally, there have been two failures in the provincial government's procurement, the first connected to the 2001 crisis, and the second in 2007, when a foreign firm that was due to provide equipment for schools, went bankrupt.

Notwithstanding these challenges, a notable feature of PERMER in Jujuy is the way it has innovated, looking at providing energy services beyond basic illumination and social communication needs. Under 'PERMER componente calórico', the programme is installing solar cookers in schools and health posts, and solar water heaters in schools. So far, around 60 water heaters have been installed in schools and another 82 are planned. In the future, PERMER will also aim to install solar heating systems in dormitories and classrooms. All of this is being undertaken directly by the provincial government, in collaboration with local actors, such as EcoAndina, and equipment suppliers.

The other innovation is 'PERMER componente frío', which is still in early stages of consideration. However, the aim would be to install solar fridges or freezers in schools and health clinics, to help with preserving food and storing vaccines. Finally, the provincial government is currently exploring the possibility of replacing existing fossil-fuel powered mini-grids with renewables, with the aim of reducing the high costs of diesel, promoting clean energy, and potentially attracting carbon finance.

6
Impacts of PERMER on residents and schools in Jujuy

This section examines the experience and impacts of solar home systems and solar thermal systems across four communities in Jujuy. Reflecting in large part the experience at the national level, the key findings are that:

- The biggest positive impacts are in schools, which benefit from more power, appliances and new solar thermal installations.
- Residential users value the better quality light, but many would like more power for domestic and productive uses, especially refrigeration and irrigation.
- User experiences and satisfaction are shaped by communities' proximity to the grid and the length of time they have had the service (c.10 years). Both resident and public service users (schools, health post) see grid access as superior.
- A key barrier to promoting energy for productive uses is the lack of prioritisation or coordination by key ministries in the provincial and local governments.

6.1 Characteristics of communities and schools

Over three days the researchers visited five communities, performing interviews in four primary schools, one health post and with 11 individual users. Four of the communities were in the department of Yavi (Quirqincho, Suripujio, Inticancha, Cara Cara), which lines the Bolivian border, and one community further south in the department of Humahuaca (Azul Pampa). Interviews were also conducted with representatives from local NGOs, Fundación EcoAndina and Warmi Sayajsunqo, which is a large, well-known women's co-operative involved in a range of activities, including microfinance and micro-enterprises. Prior to these, background interviews were conducted in the provincial capitals of Jujuy and Salta with PERMER staff, the regulators, concessionaires, a local NGO and technical institute (see Annex I).

The majority of resident interviewees were middle-aged or older men. There were three women and no young people. This bias reflects a mixture of cultural factors (related to women's unease in speaking with outsiders) and the composition of rural populations. The houses people live in are simple constructions, usually comprising two or three rooms and made with adobe bricks, with corrugated iron or straw roofs and earth flooring. While interviews with teachers were fairly in-depth, discussions with users were often short, informal conversations, conducted in the nearby school or outside their home.

The schools were all primary schools and had between seven and 28 pupils. The buildings tended to be more solid structures than homes, and in better condition. Three schools had dormitories for students who lived too far away to travel/walk daily and these also had long-term directors, who had been in post between 13 and 25 years. In general, the teachers appeared committed to their school and active in the communities.

Most of the solar PV installations in schools had taken place in 1999. Although these predate PERMER, and were funded by another

"Many families and public services want more power for more lights, TV and PC usage, refrigeration, water pumping and other productive activities"

School Director Paul Flores, standing on the roof of Carlos Pelegrini School in Azul Pampa, Jujuy. There is a solar heating and ventilation system in the foreground and solar panels in the background.

programme, the equipment installed and user experience is similar to those funded by PERMER elsewhere. Where schools had PERMER-funded solar cookers and water tanks, these were installed in the last year and a half. In general, panels for individual residences, which were funded by PERMER, had been installed a few years after those in schools, around 2001.

All the villages were located within a few kilometres of the grid network. One interesting dimension was that while one village visited (Suripujio) was in the process of being connected to the grid, another (Cara Cara) had solar panels installed just two weeks before the field visit. The limited time available and long distances meant it was not possible to visit more remote communities, where installations tend to be more recent and where there are also mini-grids – a factor which inevitably limits the type of user experience captured in this study.

6.2 Impacts in schools and health post

The main positive impact of the solar panels, mentioned by teachers interviewed, is that these provided light for studying and class preparation in the evenings, and that this was a significant benefit over what they had had previously. In one case, the teacher suggested that illumination had enabled the school to provide boarding facilities where previously it had none. In terms of educational activities, the most common comment was that the panels provided power for playing music on the stereo or the radio, and watching videos. Teachers were unable to say whether the electricity provided helped with educational performance or retention – something which had been highlighted in the 2006 study in Tucuman/Salta. This was possibly due to the length of time (11 years) they had had the panels, and the variety of issues likely to affect student retention and performance.

Criticisms of the service mainly focused on the amount of power provided. None of the teachers reported regular PC usage, either due to insufficient power or lack of equipment. In one case, where the school had no PCs, the teacher was concerned this would be a real barrier to his students entering or staying in secondary school, since they would see themselves as being behind fellow students who had computer skills. The desire to have more lights, greater TV usage and the possibility to use fridges, blenders and irons were mentioned frequently. Fridges or freezers were particular priorities for schools with boarding facilities, since they would enable more meat consumption (currently restricted to the two days following the weekly food delivery). A couple of schools had received donations of fridges from individual philanthropists, which they were unable to use as the fridges were conventional models and required more power than was available.

Staff in the school and health post in the village recently connected to the grid felt strongly that, although the solar panels had been important, grid connections provided a far superior service. For instance, the nurse at a health post emphasised that grid connections had brought better illumination and the possibility to store vaccines in a fridge, where previously they had had to be stored in a cool box and distributed within two days of arrival. She also expected grid access would enable them to provide a fuller set of medical services. For instance, they were planning visits to the village by a gynaecologist and a dentist, who previously had not come as insufficient electric power had meant they were unable to use their equipment.

The installation of hot water tanks was seen as very positive at the three schools which had them. Access to hot water helped with students' personal hygiene and with the washing of cooking utensils, cutlery, clothes and sheets. A common comment was that the tanks worked well in summer, but less well or poorly in winter, since the water freezes.

Two schools also had PERMER-funded solar cookers. These were seen as a useful supplement to existing cooking facilities, but were of a lesser-order impact than the water heaters. For instance, in one school, the existence of another, more technologically advanced solar cooker provided by the school's sponsor, and the willingness of the porter to collect firewood regularly, meant the PERMER cooker was used only occasionally. For both cookers and water heater the teachers commented that these were limited by the fact they could not be used effectively on (the rare) cloudy days.

There were a variety of views on the quality of maintenance. People felt well informed about how to register a problem and in general the teachers felt that the service from EJSEDSA was good. There were a couple of complaints, for instance, in one school that it had taken a long time for a transformer to be replaced, while in another the solar water heater was leaking visibly.

The installations in schools, and the greater amount of power and light provided here than in houses, did seem to bring wider benefits to the community. For instance, in some cases the schools were being used for activities like handicrafts and weaving workshops, religious instruction, and bathing at the weekends. In one school the teacher felt that the installation of solar panels had served as a demonstration effect, encouraging residents to request panels for themselves, after initially having been sceptical. However, NGO observers cautioned that there can be limits to this 'demonstration effect', and it depends a lot on the teacher. The pay structure in the education sector, which provides incentives to teach in the countryside, tends to attract young recently qualified teachers, or those approaching retirement, for relatively short periods. This time factor can at times limit the potential for long-term involvement and relationship-building within the community.

6.3 Impacts on residential users

The main positive impact of solar panels cited by users is that the quality of light provided is better than candles or kerosene lamps, and that it enables activities in the evening, such as reading, studying, or handicrafts. Although it was difficult to get consistent figures, the tariff seems to be less expensive than buying candles or kerosene. For instance, one user who had had panels installed two weeks prior to the field visit had previously been paying around AR$15 for a pack of 10 candles, which would usually last five days. By contrast, she expected to pay just under AR$6 in her monthly tariff to EJSEDSA. Another user in the same village had previously paid around 10-12 pesos a month to buy two litres of kerosene for two lamps. In general users seemed fairly clear on what they could use power for, and had an instruction sheet, which explained this. People appeared reasonably satisfied with maintenance services.

Our own sample was too small and conversations too short to explore age or gender differences in any meaningful way. However, government and NGO stakeholders commented that the impacts were often most marked among young people, largely because of their experience in school. For instance, because they had watched videos about the outside world, listened to the news, used mobile phones or PCs, young people seem better able than their parents had been to orientate themselves and integrate when they went to the towns. The age dimension was picked up in the conversations with users, in which some older interviewees appeared more satisfied with the basic level of power provided by the panels, since they had no plans for undertaking new productive activities. In terms of gender, EcoAndina representatives – who had long experience working on solar energy in communities in La Puna – suggested that, on the one hand, there were no big differences in usage of a technology like solar cookers, since both men and women cook; yet on the other, they noted that women

sometimes found it more difficult to understand the technical side of how different pieces of equipment worked.

Solar panel users tended to want more power, typically 24 hours a day, without needing to economise on usage, and ideally through the grid. This view is related to the fact the villages visited were located close to the grid, and in some cases were disillusioned by government promises to extend access, which had not materialised. By contrast, the local EJSEDSA technician for the area reported that communities further afield are generally more satisfied with solar panels, knowing that grid connection is difficult or unlikely – an impression widely corroborated by other EJSEDSA and government staff.

Finally, the small sample size and informal nature of interviews made it difficult to ascertain from residents if installations had had an impact on their income, economic activities or migration patterns. However, the overall impression from the fieldwork and discussions with local PERMER, NGO and school staff, was that they had not had a significant effect. A number of interviewees (PERMER, NGO, teaching staff) argued that achieving these goals would require PERMER to be part of a joined-up rural development plan, coordinated across relevant provincial government ministries, such as environment, infrastructure and economy. One headmaster highlighted that, despite the fact the community where he worked had recently gained both land titles and grid access, the local government had not used this opportunity to develop initiatives for improving the land or economic activities. Instead, the community was organising itself, for instance, by hiring a tractor.

6.4 Energy for productive and other uses

Local residents, NGOs and PERMER staff highlighted a range of additional energy needs – both for productive and domestic uses – which are not currently served by PERMER installations. They particularly mentioned energy needed for:

- water pumping (for consumption and irrigation)
- food refrigeration
- cooking
- welding and use of other machine tools
- water pumps and dryers for washing and drying agricultural products, which could then be sold (e.g. quinoa, wheat, potatoes)
- use of electric shearers and wool classification machines, thereby helping people produce more wool and achieve a higher individual price in the market

Providing energy for productive uses has been an aspiration of PERMER. However, apart from a 2003 study on productive needs in Jujuy, and responses to ad hoc requests from users (e.g. for more power to work an electric sewing machine), virtually no progress has been made to date – either in Jujuy or nationally. The main reason given for this by PERMER is that extending beyond basic illumination requires more money, more power capacity and – critically – a coordinated effort involving different ministries (production, infrastructure, energy, environment), inter alia to do proper needs assessments, capital works (digging water wells) and training and skills development in the communities.

6.5 Community participation

In terms of community participation, the interviews did not enable a proper analysis of existing or potential community organisation around energy issues; however, there are active residents associations (known here as 'communities of origin', which are related to traditional community ties), where neighbours work together on a number of issues, including to make claims to the government for new services such as grid access.

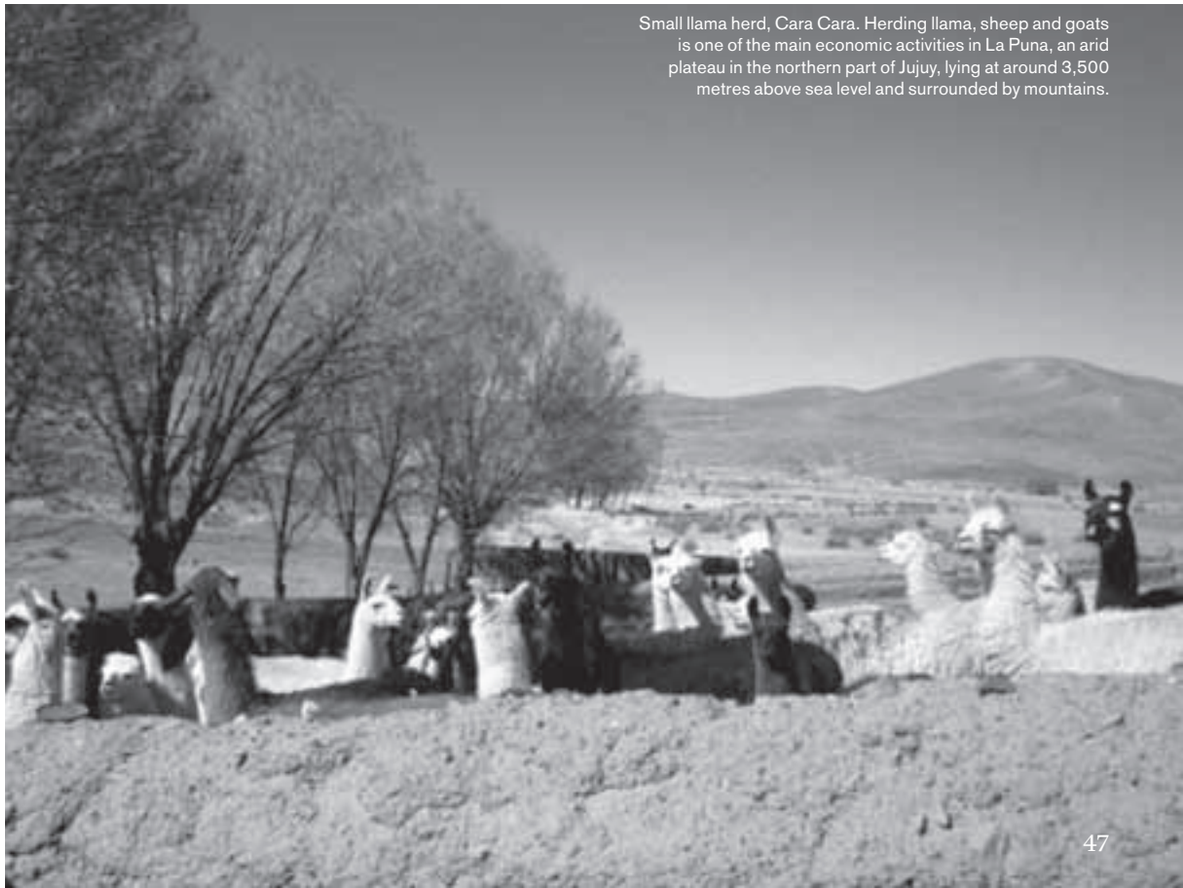
In its own work on solar energy in la Puna, the NGO EcoAndina saw a pressing need and opportunity for a more hands-on involvement by communities, particularly now that people were more familiar with solar power. These included topics like:

- user training on energy efficiency, particularly for new technologies like solar heating systems
- skills development for technicians and plumbers on installation and maintenance
- workshops to enable community decision-makers to test out and decide what solar technology applications are needed to meet local needs.

6.6 Concluding remarks on PERMER in Jujuy

PERMER has had considerable success in the province, particularly in terms of achieving installations and ensuring these are adequately maintained through a properly regulated service provider. Key reasons for the progress in Jujuy relate to the tariff subsidies provided, to Jujuy's distinct market structure and the contract obligations imposed by its concessionaire, together with the positive attitude and capabilities of key staff in EJSEDSA, the provincial government and the regulator. As indicated in PERMER's 2006 evaluation, solar installations have had the biggest impact in schools, but also have led to quality of life improvements for residential users.

This research also highlighted the significant challenges still faced by PERMER in Jujuy, particularly in terms of economic sustainability. The tariff subsidies are already high, yet EJSEDSA claims it is making a loss and will seek to raise tariffs in the current round of tariff negotiations. Other key questions centre on whether PERMER can deliver on long-held aspirations to address wider energy needs and promote more local equipment supply, both of which would require a broader, coordinated effort among government departments.



Small llama herd, Cara Cara. Herding llama, sheep and goats is one of the main economic activities in La Puna, an arid plateau in the northern part of Jujuy, lying at around 3,500 metres above sea level and surrounded by mountains.

7
Reflections and lessons learned

'They feel more Argentinean'. This was the response of one NGO worker when asked what she thought were the main social impacts of the government's programme to install solar home systems in households, schools and public services in La Puna, Jujuy. Having worked for many years with these communities, the interviewee felt one of the biggest changes was that people had a greater sense of citizenship than before. Although not dissected in detail at the time, this idea of citizenship could be seen to operate at a number of levels. For instance, through PERMER, rural communities are now receiving a basic service from their government (via a concessionaire). Through listening to the radio and watching TV, people are literally more aware of their own country, how others speak and what is happening outside their own communities. Learning to use PCs at school, and charging mobile phones, has also provided familiarity with modern technology so people can fit in more easily when they visit or move to the towns.

As this study has repeatedly emphasised, dispersed rural communities in Argentina have a range of unmet energy needs. In providing basic electricity access, PERMER only addresses a part of these needs. However, while not transformative, the changes observed are worthwhile, quality of life improvements – as the observation about people's growing sense of citizenship seems to imply. Judged in terms of its own goals of meeting basic illumination and social communication needs, PERMER can be considered broadly successful, with the greatest benefits experienced by students and teachers in rural schools.

PERMER clearly also has its limitations, which have been highlighted several times. Implementation has been slow, due a range of economic, capacity and institutional barriers. It is an expensive programme and highly dependent on subsidies. This raises questions about economic sustainability in the long term, particularly as concessionaires seek to raise tariffs in order to cover their costs and make a profit. The level and type of power provided is insufficient for many productive and domestic needs, such as irrigation or refrigeration. Also, the programme has not had much impact in terms of stimulating domestic green industries. To address broader energy needs or promote local industry, PERMER would need to have different objectives and form part of broader programmes and policies on rural development and renewable energy.

Much of this study has focused on the delivery model, which is a public-private partnership. This model, which draws on existing market and regulatory structures of a (largely) privatised distribution sector, is different from some other private-sector focused approaches for rural electrification – such as micro-enterprises, microfinance, social enterprise or commercially-driven, base-of-the pyramid business models of larger utilities – which are currently receiving significant attention in development debates and practice.

The PERMER model has some distinct strengths. The award of service contracts, enforced by regulators, appears to have been reasonably effective in ensuring equipment is properly used and maintained – an issue that has traditionally been a barrier to sustainability in off-grid renewables initiatives. As a large, government-led programme, PERMER can achieve efficiencies through centralising some procurement activities and by standardising more technical processes such as market surveys. It can also seek to achieve equality in the level of service received, through imposing uniform technical or maintenance standards on private sector contractors.

How far the PERMER model is replicable in other contexts will depend to a large degree on the underlying conditions present. For instance, the availability of investment and tariff subsidies and, the capacity of government staff, regulators and concessionaires, are clearly critical in the PERMER model. The characteristics of rural populations also have a big impact; in countries with larger, more concentrated, and less remote rural populations, a model based on multiple, small-scale service providers might be more commercially viable than in Argentina.

This research has focused principally on the impacts of installing solar home systems in one province, Jujuy, where progress is most advanced. However, the variety in energy sources and technologies used, and the different geographic, institutional and socio-economic contexts between provinces, mean there is huge value in further study of the PERMER programme, particularly in terms of the development outcomes for users. This case study ends by summarising some of the key lessons from reviewing PERMER's experience to date.

- **A concession-based approach can help create a sustainable service – but only with the adequate institutional, market, financial and regulatory conditions.** Awarding concession contracts can help ensure equipment is properly used and maintained, but this depends critically on having:
  - capable and committed government actors at national and provincial level e.g. to set market rules, run tender processes, award contracts, set tariffs and subsidies
  - an effective and able regulator to oversee service standards and penalise non-performance
  - careful design of enforceable incentives and obligations on service operators, particularly given the challenge of making rural markets profitable
  - flexibility in the local implementation model, in order to adapt to local market conditions such as different types and categories of electricity provider
  - rigidity and consistency in technical and service requirements on providers
  - adequate, sustainable, ring-fenced funds to cover subsidies
- **Serving highly dispersed, isolated, low-income populations cannot be undertaken by the private sector alone and requires major subsidies.** The high up-front costs of renewable energy technologies, particularly solar, combined with a dispersed, poor population, mean there is no or insufficient profit to attract private operators, so subsidies are needed for installations and tariffs. These need to be adequate, ring-fenced and collected from reliable, long-term sustainable sources.
- **Finance terms from international financial institutions (IFI) must provide flexibility and be country-led.** For PERMER, the loans and grants from the World Bank and Global Environment Facility have been crucial in reducing the burden on provincial government budgets, but these must provide flexibility to amend conditions in response to local conditions and external shocks.
- **The programme must factor in high up-front time and costs in development.** Initiating a nationwide programme of this ambition, which introduces new market mechanisms, unfamiliar technologies and depends on provincial government leadership, requires major time, costs and effort in its early stages. This includes for marketing the programme to provincial governments, building provincial government institutional capacity, undertaking market and feasibility surveys,

Villagers outside the school in Quirquincho, Jujuy. It has solar panels providing basic lighting, television and video usage, and a solar water heater. The community sometimes uses the school facilities, for instance for meetings, artisanal workshops or showering.

setting tariff structures, aligning procurement processes with IFI rules and so on.

- **Targets on installations must be realistic,** especially given the high initial development and logistical costs for serving dispersed markets
- **A major capacity building effort is needed with users, technicians, service providers, government institutions and regulators.** This covers technical training for users, contractors, government institutions, relevant local development agencies and NGOs on how the equipment is installed, what appliances it serves and how to be used efficiently. This also covers regulatory and administrative capacity, so that government institutions can initiate projects and supervise concessionaires.
- **While raising awareness with communities is always crucial, the required levels of participation and types of approaches may vary** by the type of technology, project and local social context. An individual solar panel, maintained by an outside operator, may require little community decision-making compared to the construction of a mini-grid.
- **Monitoring and evaluation should focus on user impacts and the effectiveness of delivery models, as well as on technical outputs.** While PERMER has a reasonable monitoring system, it would be strengthened by more regular, in-depth evaluation of its institutional operation and socio-economic impacts, including more comparative work (e.g. between provinces, technologies, type of user and service operator), which is focused on improving programme design and identifying success/failure factors.
- **Programmes must be designed to ensure users can buy and use appropriate low-power appliances.** While schools have benefited from higher power capacity of installations and the government's PROMER programme, which complements PERMER installations with equipment provision, residential users' possibilities for energy use have been restricted by a lack of local supply of low-voltage equipment.
- **Reducing rural poverty depends on integrating electrification programmes with a proper rural development plan.** Basic illumination, as that provided under PERMER, is not sufficient to relieve rural poverty or create new productive activities. This requires coordinated effort across the relevant ministries and institutions (energy, production, infrastructure, rural affairs, environment) to create a coherent rural development plan, and which looks on the range of energy needs (heating, cooking, refrigeration, water pumping, motive power etc).
- **Creating green jobs and equipment supply enterprises requires specific policy incentives and capacity-building measures.** High technical standards and volumes required in procurement, and competition from international suppliers, mean that the small-scale suppliers have found it difficult to win supply contracts. A specific national or provincial policy effort – beyond PERMER – is needed to incentivise a local equipment supply industry, particularly in terms of components and lower-tech products, such as cooking and heating systems. This can be combined with innovation and flexibility in contracting rules (e.g. smaller contracts, local content requirements). The dispersed nature of the population means there is a cost incentive and opportunity for concessionaires to train up local people in maintenance operations and create green jobs.

8
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9
Annexes

Annex A
Map of Argentina

Annex B
Summary of main amendments to 1999 World Bank loan agreement with Government of Argentina, Permer Phase 1

AMENDMENT	DATE		CHANGE
	AMENDMENT REQUEST	AMENDMENT INCORPORATED	
A	Oct 2002	April 2003	Increasing Bank financing for Solar Home Systems up to 100 per cent, after taking into account GEF financing
B	July 2003	Jan 2004	Allowing participating provinces to install SHS in public institutions in rural areas without concessionaires
C	Sep 2004	Sep 2005	Allowing the financing used for: • acquisition and instalment of PV systems in households and public services by eligible public electric utilities • solar thermal systems for water heating, cooking and space in provincial public sector entities • energy efficient equipment in provincial public facilities
D	April 2006	Jan 2007	Allow Bank financing of non-distortionary taxes on SHS and include the financing of solar waterpumping stations

Annex C
PERMER: Key institutions and roles

INSTITUTION	ACTIVITY
NATIONAL GOVERNMENT	
Secretary of Energy	Coordinates the programme through a specific unit, the Unidad Coordinadora del Proyecto (UCP), which: • Forms agreements with provinces • Draws up guidelines and standards, and verifies delivery e.g. new social and environmental guidelines for mini-grids • Oversees the planning, building and operation of installations • Decides on which projects receive PERMER funding • Manage tenders e.g. for the purchase of equipment or market studies The Department of Energy also overseas the financial administration through its internal treasury unit.
Ministry of Education	• Provides co-financing for implementing the project in rural schools, delivered through provincial budgets • Oversees that installations meet the required technical specifications • Provides equipment for use in schools with new connections e.g. TV, video
Ministry of Tourism	• Evaluates PERMER projects where they are due to be located in national parks
PROVINCIAL GOVERNMENT	
Department of Energy	Provinces set up an implementation unit, known as the Unidad Ejecutiva Provincial (UEP), which sits within the provincial energy department (which may be located within different ministries). Responsibilities include: • implementing provincial regulations needed to advance the project; • developing agreements between the provincial government and concessionary firms; • undertaking feasibility and tariff studies; • proposing projects for PERMER funding • disbursing provincial funds to support installation and tariff subsidies; • managing tenders.

Annex C (continued)
PERMER: Key institutions and roles

INSTITUTION	ACTIVITY
PROVINCIAL GOVERNMENT	
Provincial regulator	In relation to PERMER, the regulator's role is to: • certify that new users have their equipment properly installed • ensure the concessionaire responsible for maintenance meets its commitments on service quality and responds to user complaints • participate in periodic reviews of tariff levels In some provinces, like Salta, the UEP and regulator are the same staff.
Environment department	Applies relevant environmental policy
Municipalities	Provide information to feed into planning e.g. on local needs for electricity
NON-GOVERNMENT ACTORS	
Communities	Users in communities are seen as the direct beneficiaries of the project. To date, PERMER has viewed their participation as limited to: • making requests for electricity services to authorities/concessionaire • making financial contributions through payment of a monthly tariff New social and environmental guidelines developed as a condition of new World Bank financing will require greater local consultation, specifically in instances where indigenous people live and/or mini-grids are built
Concessionaire (private firm, state firm or co-op)	In relation to PERMER, the concessionaire's main role is to: • Meet the terms of service contract to maintain and replace equipment e.g. by conducting annual checks and responding to problems/complaints • Collect monthly tariff payments • Collaborate in feasibility studies and design technical plans • Manage local contractors for installation e.g. mini-grids
Contractor	Provides equipment or involved in construction

Annex D
Basic PERMER project lifecycle – key activities and actors

PROJECT STAGE	KEY ACTIVITIES AND ACTORS
Planning	• Proposal for new project emerges from – request from potential users to concessionaire/public authority or – as an initiative from the provincial government • UEP (local body of PERMER) prepares feasibility study, in collaboration with concessionaire • Concessionaire prepares technical plan • Project proposal submitted to UCP (federal PERMER body) for funding
Construction	• UEP or UCP issues tenders for equipment purchase and installation* • Contractor – often an international firm – provides equipment and subcontracts installation to local firm • Shared responsibility of concessionaire/UEP/UCP to ensure contractors meet technical, social and environmental standards
Operation	• Operation phase starts once installations are certified • Concessionaire has entire responsibility for delivery • Provincial regulator ensures concessionaire meets service commitments and monitors performance

** Originally all procurement was done at a provincial level; however, some of this has been centralised due to capacity problems causing delays at the local level and positive economies of scale gained from larger tenders*

Source: PERMER, 2008

Annex E
Key outputs and indicators provided by PERMER to World Banks

The outputs and indicators below proposed in the World Bank´s 2008 Project Paper for a US$50 million loan extension agreement to the Argentine Government for PERMER. The paper notes that these include minor amendments on the original indicators to take account of lessons learned and changes to the implementation model.

OBJECTIVE/OUTPUT	INDICATOR	TARGETS		
		2009	2010	2011
1 Increase access to electricity services and the quality of associated uses for rural population	Installed SHS in households	0	6,075	9,500
	Installed WHS in households	0	50	100
	Total number of households served by PERMER	0	7,401	10,876
	Installed SHS in public buildings	48	108	474
	Installed solar systems in public buildings for thermal applications	21	58	59
	Installed solar systems in public buildings for water pumping	0	0	30
2 Increase private sector participation in the off-grid rural electricity market	Number of operators under PERMER	14	16	16
	Number of private concessionaires operating under PERMER	4	4	4
	Number of residential systems operated by private concessionaires	0	6,075	6,075
	Number of systems for public services operated by private concessionaires	0	8	143

Annex E (continued)
Key outputs and indicators provided by PERMER to World Banks

OBJECTIVE/OUTPUT	INDICATOR	TARGETS		
		2009	2010	2011
3 Number of systems for public services operated by private concessionaires	Average tariff subsidy for residential systems (%)	70	70	70
	Average retail tariff for households (Pesos/ month/customer)	10	10	10
4 Increase renewable energy use and reduce CO_2 emissions	Avoided CO_2 emissions (tons CO_2eq)	34	465	840
	Total installed capacity SHS (KW)	60	800	1,440
	Total installed capacity WHS (KW)	0	30	60
	Total installed capacity of RET based mini-grids (KW)	0	2,320	2,320
5 Strengthen regulatory framework associated with off-grid electricity service	Percentage certifications of installed systems	90	95	95
	Percentage of complaints attended without subsequent complaint	90	90	90

Source: World Bank, 2008. *World Bank Project Paper on Additional Financing Loan in the Amount of US$50 Million to the Argentine Republic for the Renewable Energy in the Rural Market Project.*

Annex F
Sample of indicators for PERMER evaluation

The indicators developed for PERMER in the 2006 evaluation are extensive and cannot be reproduced here in full. The table below provides examples of the key areas of data collection, focusing on the social and economic impacts.

AREA	CHARACTERISTICS AND CHANGES MONITORED (EXAMPLES)
Socio-economic characteristics of users / local population	• Household (h/h) composition; • occupation; • enterprise activities; • income & welfare payments • educational attainment; • access to health services; • housing conditions; • cooking equipment and fuel • transport means; • rates of out-migration from rural areas; • reasons for non-adoption of service
Use of service (residents, public services, small enterprise users)	• Use of PERMER service (illumination, social communication, productive activities) • Cost and useful life of bulbs and equipment • Rate of substitution from other energy sources • Level of met/unmet demand for electricity • User satisfaction (service quality, maintenance)
Economic changes	• Cost and affordability of service; • changes in economic activity; • changes in technology use; • adoption of non-traditional economic activities; • changes in income levels
Social changes	• Changes in migration rates; • health services; • the length of the active day; • social or family meetings and events; • cultural activities; • attitude towards electrification process

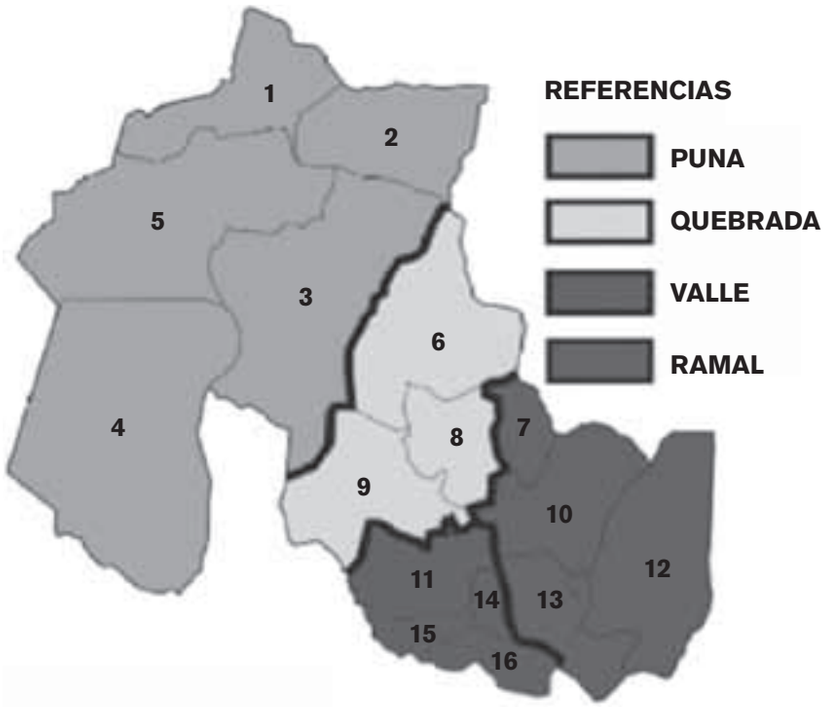
Annex F (continued)
Sample of indicators for PERMER evaluation

AREA	CHARACTERISTICS AND CHANGES MONITORED (EXAMPLES)
Impact in schools	• Student retention and absenteeism; • educational performance; • pedagogical methods; • school-community relations
Impacts in health posts	•Changes in services provided and typical illnesses/diseases recorded
Communication and training	• User knowledge of project, service and complaints system • Communication and training methods (of regulator, concessionaire, PERMER)
Provincial government performance	• Quantity of planned vs. achieved connections; • average subsidy levels; • installation and operational costs (of PERMER); • organisational effectiveness
Regulator performance	• Quantity of certified systems; • management and results of user complaints
Concessionaire performance	• Quantity of certified systems; • frequency of maintenance visits; • rate of resolved complaints
Environmental impacts	• Avoided CO_2e emissions

Source: PERMER, 2006

<u>Annex G</u>

Geographic zones and departments of the Province of Jujuy, Argentina

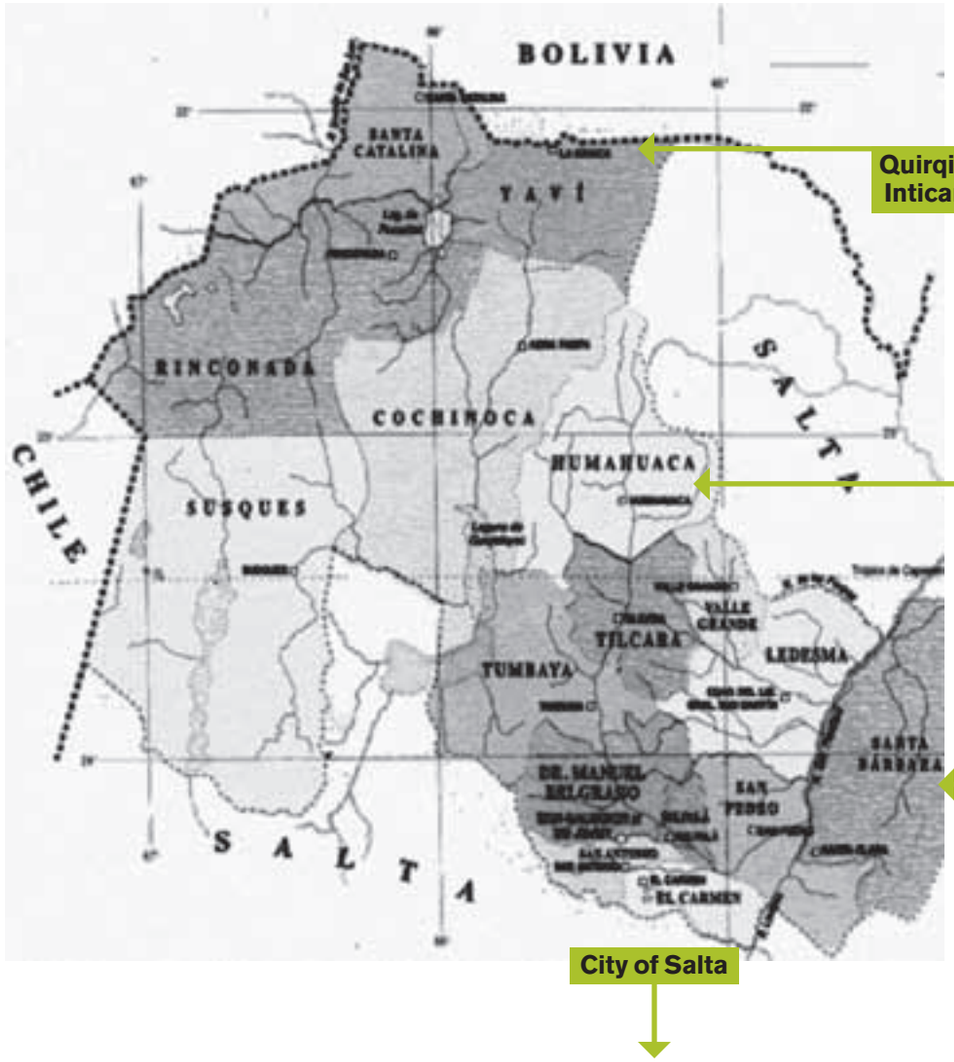


REFERENCIAS

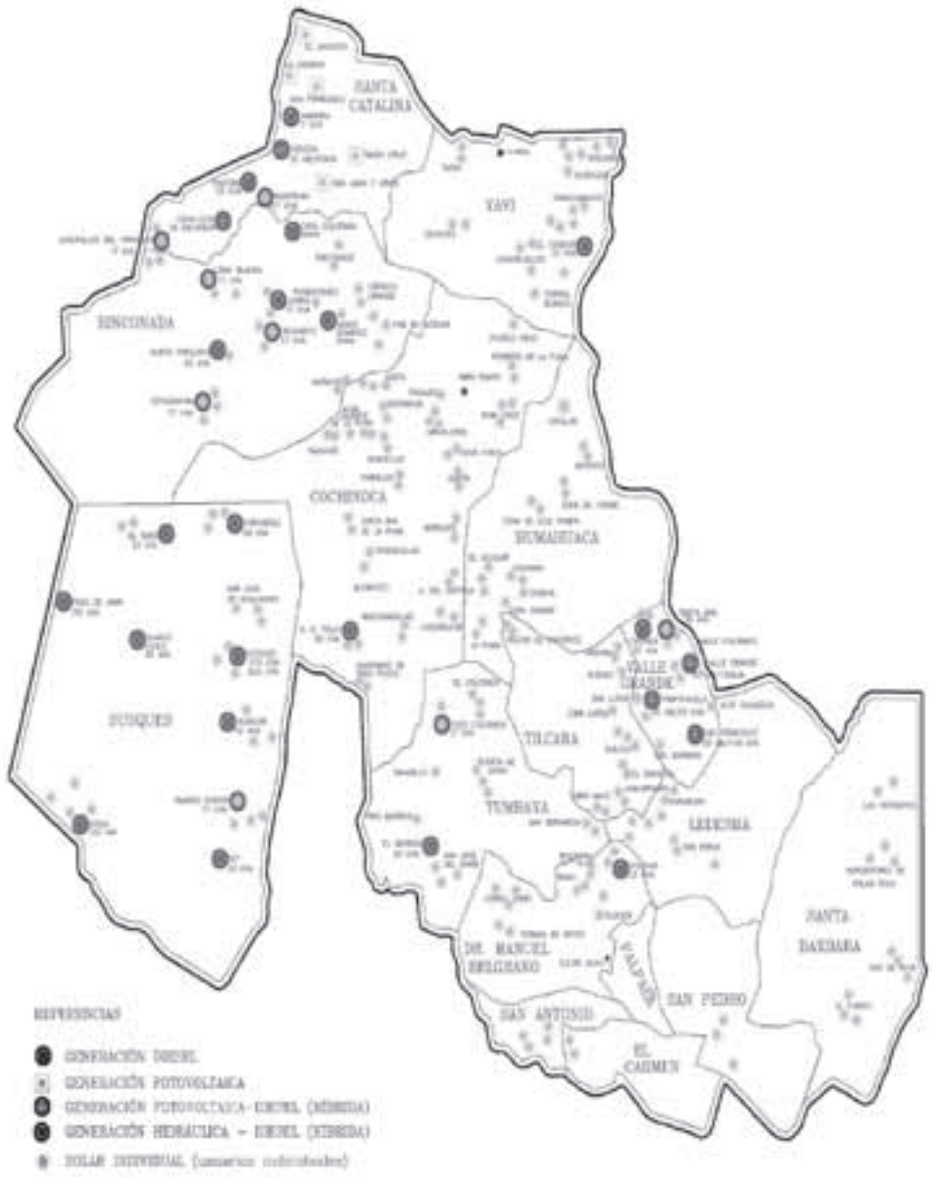
1 Santa Catalina
2 Yavi
3 Rinconada
4 Susques
5 Cochinoca
6 Humahuaca
7 Valle Grande
8 Tilcara
9 Tumbaya
10 Ledesma
11 Dr. Manuel Belgrano
12 Santa Bárbara
13 San Pedro
14 Palpalá
15 San Antonio
16 El Carmen

National and provincial borders, Jujuy Province

The map below indicates the borders between Jujuy and the province of Salta, Bolivia and Chile, together with the departmental divisions and interview locations.



Annex H
EJSEDSA operations in Jujuy by technology type



Annex I
Interview schedule

ORGANISATION	INTERVIEWEE	ROLE	DATE (2010)
PERMER, Energy Secretariat	Victor Russo	Head of PERMER UCP (central co-ordinating unit)	31 Aug
PERMER, Energy Secretariat,	Marta Carrizo	PERMER coordinator, UCP, Environmental and Social specialist	Various background meetings, June and Aug-Oct 2010
PERMER, Energy Secretariat	Liliana Aleman	PERMER coordinator, UEP (provincial executive unit) for 6 provinces, including Jujuy	11 Sep
Ministry of Infrastructure and Planning, Jujuy Province	Ricard Souilhe	Executor of PERMER (UEP) for provincial government of Jujuy	6 Sep
Public Services Regulatory body, Se.Su.Pu, Jujuy	Rodriguez Francile	Head of Se.Su.Pu	6 Sep
Public Services Regulatory body, Se.Su.Pu., Jujuy	José Ovejero	Technical manager for energy services	
Public Services Regulatory body and PERMER UEP, Salta	Pierre Riaszer	Regulator of rural energy market / Executor of PERMER	3 Sep
Ministry of Infrastructure and Education	Nestor Lluch	PERMER/PROMER team member	2 Sep
Ministry of Infrastructure and Education	Rudolfo Hueso	Technical lead on PERMER/PROMER	2 Sep
World Bank	Lucia Spinelli	Energy specialist, PERMER co-lead	1 Sep
EJSEDSA (Concessionaire for rural market, Jujuy)	Carlos Arias	Managing Director	7 Sep
EJSEDSA	Hidalgo Silvano	Maintenance Technician, Department of Yavi, Jujuy	10 Sep

Annex I
Interview schedule

ORGANISATION	INTERVIEWEE	ROLE	DATE (2010)
ESEDSA (Concessionaire for rural market, Salta)	Daniel Biurran	Managing Director	3 Sep
Fundación EcoAndina	Silvia Rojo	President	7 Sep
Fundación EcoAndina	Barbara Holzer	Director	7 Sep
Asociación Warmi Sayajsunqo (women´s association, Jujuy)	Rosario Quispe	Head	10 Sep
INENCO (Institute of Non-Conventional Energy), University of Salta	Ricardo Caso	Professor	3 Sep
Fundación Bariloche (Energy Institute)	Daniel Bouille	Vice President	25 Aug
USER INTERVIEWS (SCHOOLS, HEALTH POST, RESIDENTS)			
VILLAGE	**SCHOOL**	**INTERVIEWEES**	**DATE**
Quirquincho	2 de Junio, Escuela 208	School Director 2 residents	8 Sep
Suripujio	Exodo Jujeño, Escuela 170	School Director Health post nurse 2 residents	8 Sep
Inticancha	Marcelo G Marquez, Escuela 303	School Director 2 residents	8 Sep
Cara Cara	N/A	5 residents	9 Sep
Azul Pampa	Carlos Pelegrini, Escuela 210	Director	10 Sep

How can governments, donors and businesses work together to provide poor communities with low-carbon energy?

This study analyses an Argentinean programme that has successfully delivered basic electricity access to remote rural communities that are beyond the reach of the grid. PERMER (the Project for Renewable Energy in Rural Markets) has already provided a combination of renewable (solar and wind power) and hybrid fossil fuel-renewable energy (e.g. diesel-solar mini grids) to around 10,000 households and 1,800 schools and other public buildings, and plans to reach another 18,000 households in its current phase. PERMER has used government and donor funding to install generating equipment and subsidise user tariffs, with exclusive delivery contracts awarded to concessionaires that run and maintain the service.

The programme has provided better quality and safer illumination to households at costs that are equivalent to, or lower than, what residents paid previously for kerosene lamps and candles. However, power supply has not been sufficient to meet all local needs, in terms of domestic and productive activities, as well as in public services like schools and health posts. Progress on the programme has also been much slower than expected and capital costs have been higher. Some private-sector concessionaires complain that tariffs are too low for them to make a profit. This report describes PERMER's delivery model, its successes and challenges, and the social impact on residents and schools. It focuses on Argentina's north-eastern province of Jujuy, one of the poorest and most remote provinces, and one of the first to implement PERMER.

The International Institute for Environment and Development (IIED) is an independent policy research organisation. IIED works with partners in middle- and low-income countries to tackle key global issues – climate change, urbanisation, the pressures on natural resources and the forces shaping markets. IIED's work on energy aims to address poverty and energy security issues by supporting access to sustainable, affordable energy services for the poorest, as well as promoting responsible practice in larger-scale energy sector development, including biofuels, oil and gas, and stimulating debate around energy policy reform.

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International Institute for Environment and Development
3 Endsleigh Street
London WC1H 0DD
United Kingdom
Tel: 44 (0)20 7388 2117
Fax: 44 (0)20 7388 2826
Email: info@iied.org
www.iied.org

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