Global
Sustainable Electricity
Partnership

Promoting the development of local renewable energy sources to provide a sustainable and reliable electricity service to remote communities.

The Argentina Patagonia Renewable Energy Projects

GLOBAL SUSTAINABLE ELECTRICITY PARTNERSHIP

The Global Sustainable Electricity Partnership (GSEP) —which comprises the leading electricity companies from the global electricity sector—promotes sustainable energy development through electricity sector projects and human capacity building activities in developing nations worldwide. Our projects and activities are mainly financed by our member companies, who also contribute in-kind resources for their execution.

The opening of our membership to major electricity companies from emerging countries emphasizes our commitment to a truly global mission of promoting sustainable energy development.

MISSION

Our mission is to play an active role in global electricity issues in an international framework and to promote sustainable energy development. This diverse international group offers electricity sector skills and practical competencies in electricity generation, transmission and distribution. With international field-proven expertise in the planning, management, design, operation and maintenance of energy facilities, member companies assist and share their know-how in the effective implementation of sustainable energy development with counterparts in developing and emerging countries.

MEMBER COMPANIES

American Electric Power
United States

Comisión Federal de Electricidad
Mexico

Duke Energy
United States

Électricité de France
France

Eletrobras
Brazil

ENEL S.p.A.
Italy

Eskom
South Africa

Hydro-Québec
Canada

Iberdrola
Spain

JSC "RusHydro"
Russia

Kansai Electric Power Company, Inc.
Japan

RWE AG
Germany

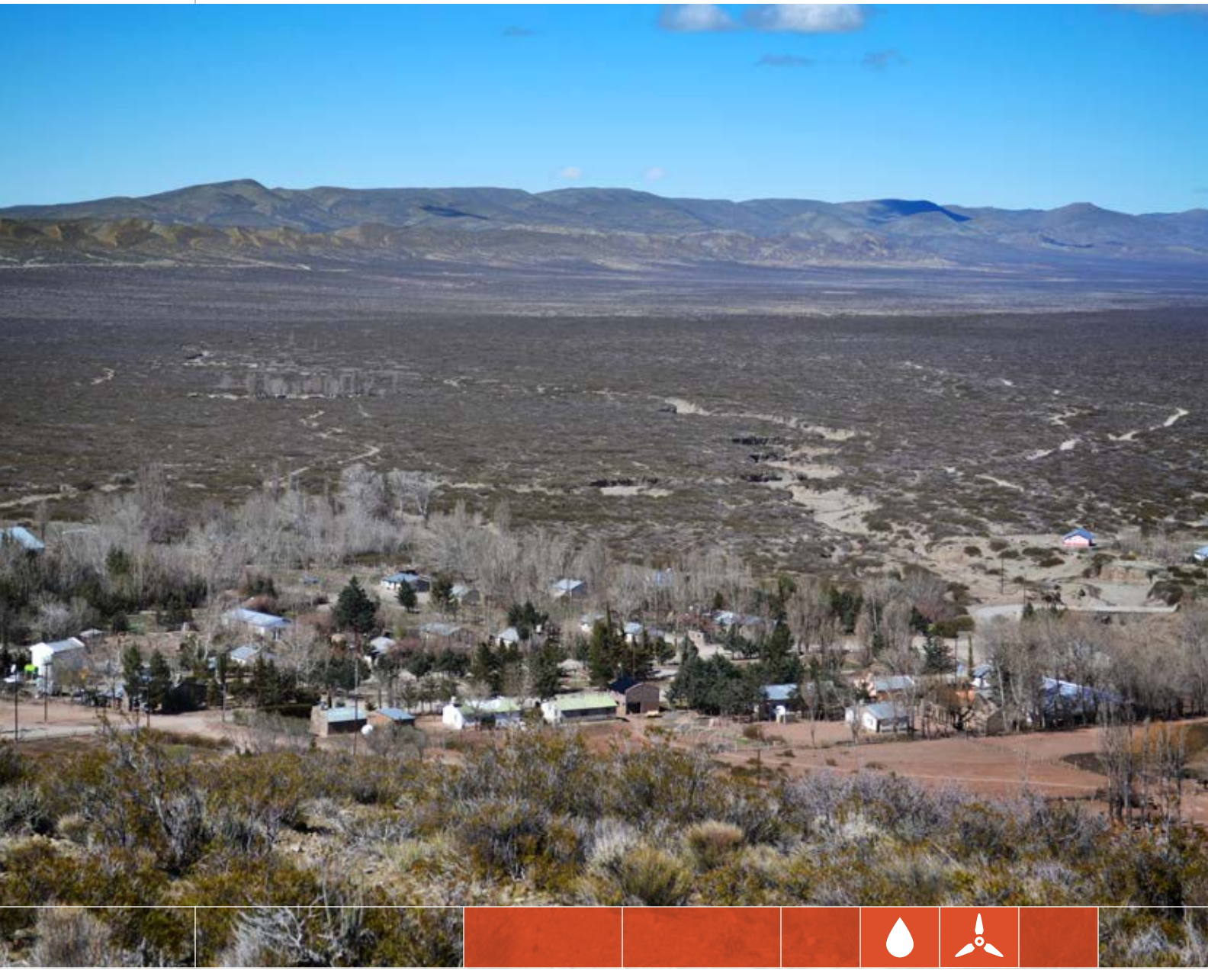
State Grid Corporation of China
China

Tokyo Electric Power Company, Inc.
Japan

Content

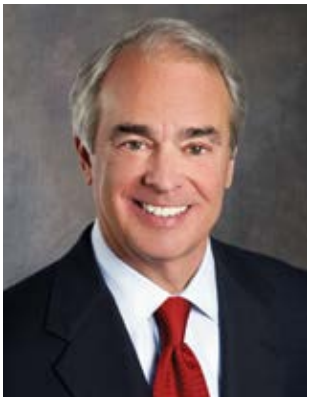
The Argentina Patagonia Renewable Energy Projects

Cochico Micro-hydro Project and Chorriaca Wind-Diesel Hybrid Project



Chorriaca, Argentina

Messages from GSEP and Duke Energy



High in the desert in northern Patagonia sits a new micro-hydro station and powerhouse where, once, only goats wandered and residents gathered firewood. Several hours south, through a rugged mountain landscape, three wind turbines are now perched high on a hill using the Patagonian breeze to light a small town.

The Cochico and Chorriaca projects are the first GSEP has built simultaneously in two separate locations, using two different renewable energy resources. The clean power being produced has replaced the aging, unreliable, expensive and dirty diesel engines that used to run intermittently in both locations. For the indigenous Creole in Cochico and the Mapuche in Chorriaca, life has changed.

The Cochico micro-hydro project utilizes a swift-running glacial creek with sufficient flow even in the dry season. In Chorriaca, meteorological records kept for the last seven years prove that a persistent wind will keep the power flowing, although a diesel generator set with a much more efficient system will remain on stand-by for back-up purposes.

GSEP partnered with the local electric utility and distribution company in Neuquén Province – EPEN – to make this project a reality. In addition to eventually taking over the system, EPEN is building a transmission line in each of the locations and will handle customer interface. Moreover, EPEN has agreed to reinvest the savings created by the projects (produced by the fuel savings) in new renewable projects in the Province of Neuquén.

The projects enjoyed tremendous support from provincial Governor Jorge Sapag and other government officials. For example, the Provincial Road Agency agreed to build access roads in both locations and keep them in good condition during the complete construction period.

A record seven of GSEP's companies – Duke Energy (lead), American Electric Power, Enel, Eletrobras, Hydro-Québec, RWE and RusHydro – made a direct contribution to these projects.

Jim Rogers
GSEP Chairman 2012-2013
Former Chairman, President and CEO
Duke Energy

Message from the Provincial Governor

In my childhood I traveled across each corner of the province of Neuquén hand in hand with my father and my mother. I got to know the simplicity of all its inhabitants, their natural cordiality, their hospitality. In each of their gestures there is an invitation to love them, because they convey the love they feel toward the land. Anyone who has ever been to any spot in the mountain range of Neuquén must have felt the human warmth that is expressed by few, fair and honest words.

It's impossible not to feel the same happiness that they have due to the completion of an old dream, which they had been patiently awaiting for so long.

Knowing that each family will be able to enjoy clean and permanent energy, that their lives will be more comfortable, that the new electricity will allow them to enjoy their homes much more after having struggled for so long, fills me with happiness and renews my strengths and hopes.

This desire has now become a project on which, EPEN- the distribution company responsible for the future maintenance of the two plants- has been working since the beginning. I am deeply grateful to Duke Energy and to the GSEP, for their contribution as well as for having chosen Neuquén and especially, Cochico and Chorriaca, to install the power plants.

I also want to mention the commitment, effort and dedication of those who worked day after day in the construction of the plants; and finally, I would like to express my gratitude to the neighbours of this wonderful place, who boast an unbeatable will and who now can see their dream come true.

Jorge Augusto Sapag
Governor of the Province
of Neuquén

Message from EPEN

When in the middle of 2010 we started to work together in these projects, we had great expectations. As we moved forward through the different stages of project development and approval, these expectations started to be fulfilled little by little, and also generated new dreams.

Today, we see with satisfaction how the confluence of wills and the association of public and private efforts have become an essential tool in providing effective solutions to society, not only to meet basic and essential needs, but also to contribute to the development of renewable energy sources and climate change mitigation.

The Ente Provincial de Energía del Neuquén (EPEN), is the provincial State entity that manages investment in electricity infrastructure to supply all corners of the province. But it was owed to both the Chorriaca and, especially, the Cochico communities, an uninterrupted power supply. Thanks to the invaluable contribution by GSEP and the combination of efforts, this debt is being paid. Otherwise, it would have been almost impossible. The inhabitants of these communities now have electricity to achieve their dreams of local development.

I want to express my appreciation to the EPEN team, which collaborated with the project and the work, as well as to the various provincial agencies, which were able to appreciate the importance of this project. Likewise, I am very thankful to GSEP and its partners, in particular Duke Energy, for their contributions and interest in our province of Neuquén. I am very pleased to have known people of such noble human qualities. A huge thank you also to the authorities and people of Chorriaca and Cochico, without whose permanent support this would not have been possible.

I take great personal satisfaction and am further motivated to continue working to supply a basic and essential service that has contributed to enhance the engineering function, bringing it closer to the people's actual problems.

Francisco Zambon
General Manager
Ente Provincial de Energía
del Neuquén

Message from the Project Manager

In 2010 we were faced with the challenge of planning and installing two renewable energy projects that could be replicated in other communities. From that moment until we finally started construction of the generating units, the challenges piled up… and satisfaction as well. It is very encouraging to be able to work on these projects, which are proof of how renewable energies can contribute to electrify isolated communities. We are sowing the seeds of change.

Cochico and Chorriaca had no available electricity 24/7. Now, they can improve their living conditions, health, and education, and reduce the migration of young people who used to move to other locations due to the lack of work and opportunities.

I wish to thank GSEP, which is a unique partnership that demonstrates that it is possible to change to renewable energies around the world. I also appreciate the support of the Neuquén province and the communities of Cochico and Chorriaca, and the commitment of the member companies that were key factors for the success of the projects. I especially want to congratulate the team, which has been lovingly committed to the projects since day one, and thanks to which we were able to deal with every challenge that we encountered during their development and implementation.

This is a clear motivation for me to continue to demonstrate that change is possible.

José Tierno
Project Manager
Argentina- Patagonia Renewable Energy Projects
Commercial Director
Duke Energy Argentina

Message from the President of the Cochico Development Commission

I saw Cochico grow. I was the first President of the Development Commission. Today, I'm happy because I see that what I've always dreamed of has become real: electricity. One of the most important things is energy.

Living without energy is very difficult. People got used to this situation; however, having power now allows us to change our dietary habits and eat fresh food, to improve our health as well as to create new sources of work. We want young people to stay in this community to allow Cochico to grow, and their future will be different too. We want to help them improve and encourage them to take courses so they can get better jobs.

Today, I see the joy that people have when I look at their faces. It is something that they have been awaiting for many years. Cochico has made progress, and hopefully we will live long to see further progress; that is my hope. I anticipate a good future for all of us and I can see the conditions to make it happen.

Domingo Rodrigues
President
Cochico Development
Commission

Message from the President of the Chorriaca Development Commission

For all of us, this is a highly anticipated project. It is essential for our Mapuche community because Chorriaca must continue to grow. From now on, we, as citizens, will continue to support our community as much as we can. Many children are being raised in this community, and we look forward to a better future for them.

When I arrived at Chorriaca in 1987, there was an electrical generator that only generated power from 8 a.m. to 12 p.m. and from 7 p.m. to 12 a.m. Today the situation is completely different. Today, more work can be created. This is already a reality and not just words. As a result of this, Chorriaca will grow even more. Thanks to the people who worked on this project and to the companies that participated in it.

José Burnes
President
Chorriaca Development Commission

Message from the Chorriaca's Lonko

I am very grateful to the companies and to the governor of the province for supporting this project, which provides better energy in this QuilapI Mapuche community. We have been looking for the possibility to improve our community for a long time. Finally, we have obtained the energy service we have been hoping for –we have suffered from poor heating and other services for many years. This is going to create new jobs and opportunities for the young people. Thank you on behalf of the community. I am also grateful to God for what has been achieved.

Juan Bautista Quilapi
Lonko [Mapuche Community Chief]
Chorriaca

Cochico and Chorriaca are small communities in the province of Neuquén in the Patagonian region of Argentina. Both isolated from the national grid, they rely on diesel units that operate on a discontinuous basis for their electricity.

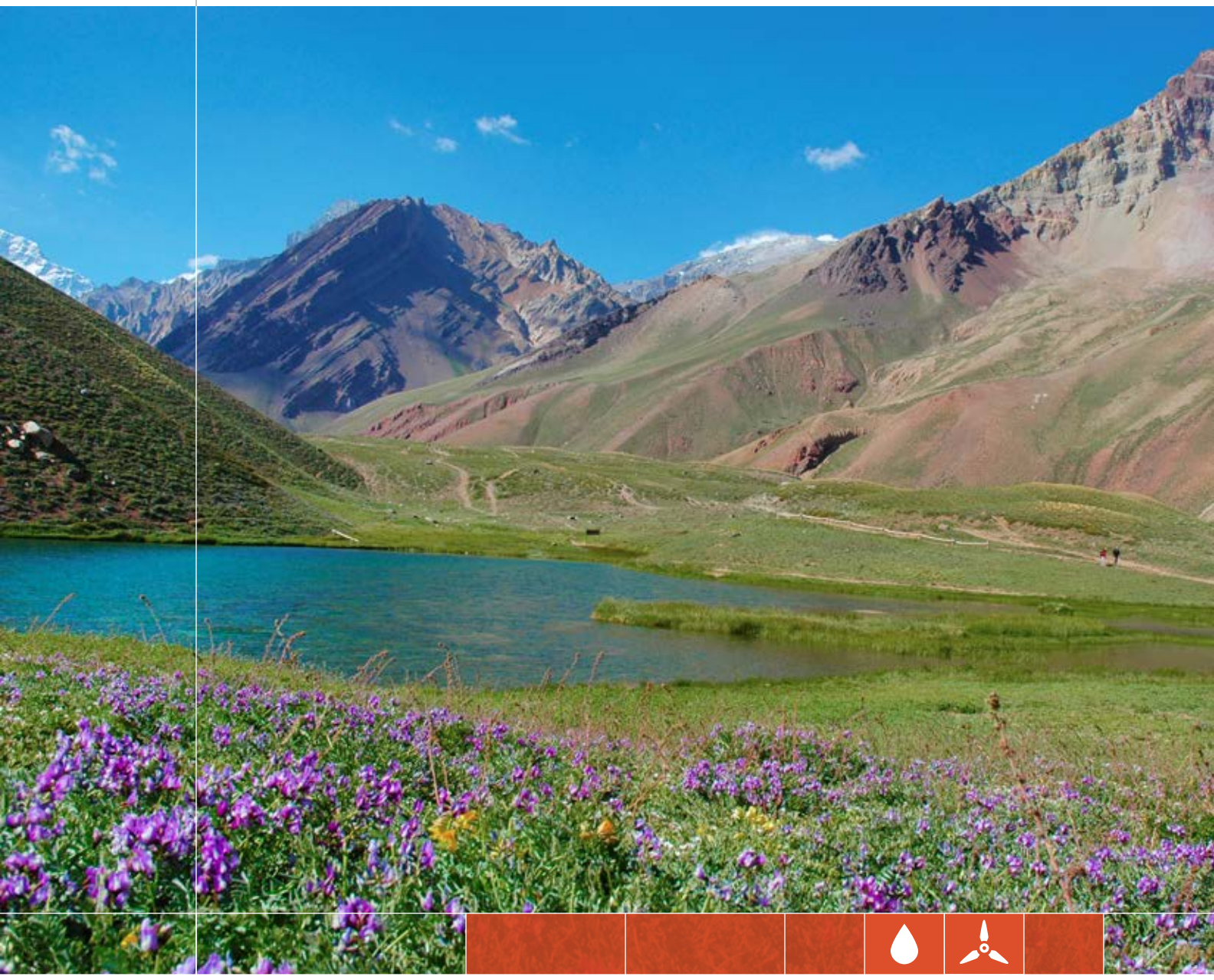
The Argentina Patagonia Renewable Energy Projects aim to provide these communities with access to a sustainable electric service 24 hours a day, 7 days a week, using local renewable energy sources. The projects feature the design and installation of a 65 kW micro-hydro facility in Cochico and a 75 kW wind- 120 kW diesel hybrid plant in Chorriaca.

In line with national and provincial interests to develop renewable generation in general, and wind energy in particular, these projects will not only contribute to the communities' social and economic development, they will also displace all the diesel currently used in Cochico, and a considerable portion in the case of Chorriaca. This will reduce CO_2 emissions and lead to fossil fuel savings while substantially reducing negative environmental impacts such as noise pollution.

Furthermore, these projects will provide a pilot experience for the development of renewable energy in isolated communities on the basis of locally available resources. A key objective of the projects is to promote the scaling up of renewable energy projects in the region. The fuel savings generated by the cleaner energy production of both projects will be used by our local partner for the development of new renewable energy projects in the region. The transfer of technical know-how and experience will also help build human capacity for the development, operation and maintenance of such systems in a number of similar isolated towns within the province of Neuquén and in Argentina.

Access to sustainable electricity can significantly improve the quality of life in remote rural regions in developing countries. The Argentina Patagonia Chorriaca Wind-Diesel Hybrid and Cochico Micro-hydro Projects will showcase the importance of developing sustainable, renewable energy as a way to support the social and economic development of otherwise isolated communities, and to fight climate change.

The Argentine Republic



Aconcagua National Park, Argentina

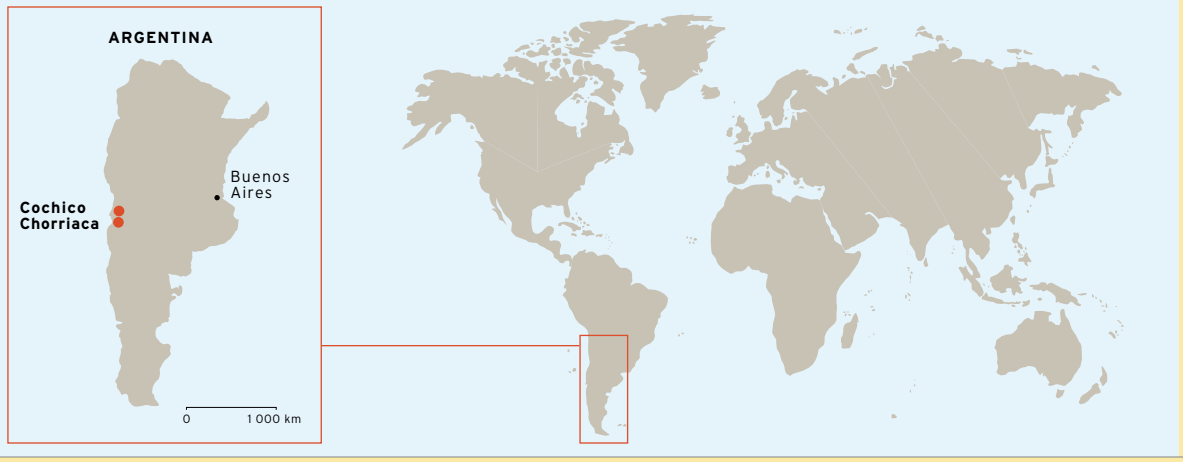
Introducing Argentina, Chorriaca and Cochico

The Argentine Republic is the second largest country in South America, bordering Chile to the south and west, Bolivia and Paraguay to the north, and Brazil and Uruguay to the east. Covering over 2.7 million km² in surface area, Argentina is home to over 40 million people. Around one third of the population lives in the capital city of Buenos Aires[1].

Our two projects are located in the region of Patagonia, more specifically in the Province of Neuquén. Chorriaca and Cochico, the beneficiary communities of the wind-diesel hybrid power plant and the micro-hydro power plant, respectively, are small rural villages in Neuquén isolated from the national energy grid.

1. Central Intelligence Agency. "Argentina". cia.gov. Central Intelligence Agency, 15 Mar. 2013. Web. 22 Mar. 2013.

LOCATION OF CHORRIACA AND COCHICO



GEOGRAPHY

Argentina has a diverse geographical landscape that ranges from tropical climates in the north to tundra in the far south. The rugged Andes mountain range lies to the west, while the fertile Pampas plains are found in the north and the Patagonia plateau in the south.

Cochico is situated in the northern region of the Province of Neuquén, in the Coyuco valley. The Coyuco valley ranges between 900 and 1,400 meters above sea level. It begins at the north of the Domuyo volcano and follows along the stream and the hills of the same name. The Coyuco hills are located at 2,900 meters above sea level. The Domuyo volcano creates a natural barrier at the south of the provincial territory. At the south of the mentioned valley, there is a volcanic caldera which runs from west to east. Where Cochico is located, high rainfall averages are mostly recorded in the autumn season, decreasing substantially during the spring and summer seasons.

Chorriaca is located towards the center-west of Neuquén between two mountain ranges, the Chorriaca Mountains to the north and the Salado Mountains to the southeast. The Mulichinco Hill, to the west, has the highest elevation in the area (1,945 meters above sea level). The prevailing weather is arid and semiarid, typical of the Patagonian steppe. The mean annual temperature is 12 ºC. The average precipitation diminishes from the west to the east according to the land relief, with an annual average of about 250 mm per year, as registered at the Chorriaca pluviometric station. Snowfall varies between 20 and 30 cm. Prevailing winds are from the south quadrant, in particular from the southwest.

Patagonian landscape in the summer

Snowcapped Andes mountains in Argentina

DEMOGRAPHIC AND SOCIOECONOMIC OVERVIEW

Argentina has a service-driven economy. Rich in natural resources, the country also has a strong export-oriented agricultural sector and a diverse industrial base. Despite being the third largest economy of Latin America, around 30% of the population lives below the poverty line[2]. Poverty is mostly concentrated in rural areas, where many of the indigenous people live. These communities tend to be in remote areas far from public services.

Indigenous communities in the province of Neuquén have maintained their culture and lifestyles within their territories, called "reservations," and their claims to the federal state for recognition of their properties continue to this day. The absence of fences to delimit land is due to the underlying principles that production and resources should be managed on a communal basis, principles that remain to this day a main feature of Neuquén's livestock raising. Mapuche people, who over time were confined to reservations, maintained their identity and culture among the different communities by keeping true to their beliefs of common ownership of land, the basic social organization of the Mapuche (consisting of a family clan or lineage that recognizes the authority of a lonko or chief), raising livestock as the main activity and their vision of human existence and transcendence.

Livestock production has been a major activity in the Neuquén province. Currently, livestock production occupies more than 70% of the use of the provincial territory. With the development of the oil industry in the area of Cutral Có and the fruit industry in the central area of Alto Valle de Rio Negro and Neuquén, all of which were considered by provincial policies to be higher priority economic activities, livestock production now plays a secondary role in the provincial economy.

2. Central Intelligence Agency. "Argentina". cia.gov. Central Intelligence Agency, 15 Mar. 2013. Web. 22 Mar. 2013.

Resident of Cochico leads his horses back home

Woman tending her garden in Cochico

TRADITIONAL MODELS OF SUBSISTENCE

In both Cochico and Chorriaca, the land-livestock-family labour production model for subsistence has historically been the traditional socioeconomic standard. These local peasant-like forms of production are historically and culturally characterized by seasonal migration. Summer pastures are found in the higher valleys, which in many cases exceed elevations of 1,200 m above sea level. This environment provides pasture and water for the herds during the summer. The animals can stay there between three and five months, depending on the distance to the winter pasture fields and the height of summer pasture fields. Winter grazing is done on the plateau and lower valleys where water and pasture scarcity is critical in the late spring. The migratory circuit does not have a synchronized length; the distances vary considerably by region, from a few kilometres to over 200. The variation in both the date of departure and arrival depends on weather conditions, the location of the fields and the distance between them. The practice of seasonal migration is widespread in Cochico, Chorriaca and many surrounding villages, a result of successive systematic and practical knowledge transmitted from generation to generation over centuries.

Small stock producers in Cochico and Chorriaca use small portions of land where title to property is uncertain. They mainly use the land for grazing goats. Their economy is focused on subsistence, with a poor saving capacity. The small-stock producers in both villages pay annual rental rates for grazing on state lands. This right of use is transferred from one generation to another. The absence of titles prevents access to additional financing sources as the risk that the land may be seized by new occupants is perceived as high.

Goat herding in Chorriaca

Chorriaca's next generation

POLITICAL SYSTEM

Argentina is a federal democratic republic, regulated by a system of checks and balances between its legislative, executive and judicial branches, as defined by its constitution. The President is both the chief of state and the head of government. President Cristina Fernandez de Kirchner was re-elected to office in 2011. A bicameral National Congress leads the legislative branch, consisting of the Senate and the Chamber of Deputies, both elected by direct vote. The President's political party, the Front for Victory, holds 44% and 45% of the seats in the Senate and Chamber of Deputies, respectively. The Supreme Court and lower federal courts make up the judicial branch.

There are 23 provinces in the country, in addition to the federal district of Buenos Aires, the capital city. Each province has its own government with a local constitution. Provinces retain all power not specifically reserved for the federal government, as outlined in the constitution.

The village of Cochico has existed in its current location for a very long time. However, its County Development Commission, the political unit under which it is organized, has only been in place since 2002 with 6 civil servants in office. Since 2010, the authorities in charge have been of indigenous descent. They have been successful in carefully managing the County Development Commission's resources for the past decade and their persistence to obtain a source of electricity for the village, for both present and future generations, should be highlighted, as it is a main reason for the success of this project.

Chorriaca, whose name comes from "ChorrI or Chori" (small jumping lobster), has also been organized under a County Development Commission since 1986.

National Argentine Congress in Buenos Aires

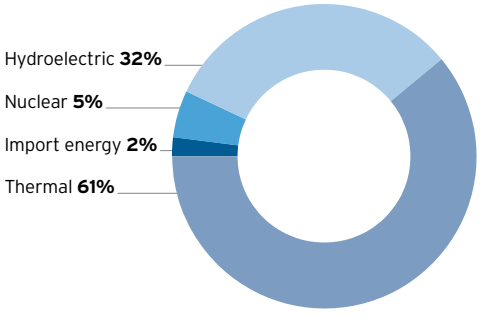
Argentina's Power Sector

Argentina is South America's largest natural gas producer and a significant producer of oil. The country's electricity generation comes mainly from these thermal sources, while one third of the electricity generated is supplied by hydropower[1]. The vast majority of Argentina's power generation is interconnected through the country's interconnection system known as SADI.

1. U.S. Energy Information Administration. "Argentina – Analysis". eia.gov/countries. U.S. Energy Information Administration, 24. Jul. 2012. Web. 25 Mar. 2013.

Thermal power plant near Buenos Aires, Argentina

SOURCES OF ELECTRICITY GENERATION IN ARGENTINA



"Sources of Electricity Generation in Argentina" data from 2011.

ENERGY POLICY AND REGULATION

The Energy Secretariat (SENER) is in charge of national energy policy. The electricity sector was unbundled by the reforms introduced by Law 24.065. Ratified in 1991, the law also authorized the SENER to set overall electricity policy. It created the Ente Nacional Regulador de la Electricidad (ENRE), which is responsible for the approval of rate changes and the issuance and enforcement of regulations governing the transmission and distribution of electricity. The law also established a not-for-profit entity, which is now known as the Compañía Administradora del Mercado Mayorista Eléctrico (CAMMESA), to oversee the wholesale spot market for electricity sold to distributors or directly to large users.

Electricity transmission and distribution are highly regulated public services at the federal level. In contrast, generation operates in a competitive market with open access to transmission and distribution. Consumers are divided into large users and residential consumers.

ELECTRICITY DEMAND AND POWER SYSTEM

National electricity demand in 2011 reached 116,381 GWh, representing a 5.1% increase over the previous year[2]. The country imported 2,412 GWh of power from neighbouring countries in 2011, slightly more than in 2010.

The region of Comahue, which groups the provinces of Rio Negro and Neuquén, was responsible for 4% of the national energy demand[3]. Of the total 29,523 MW of installed capacity in the country, 21% is found in the Comahue region, mostly hydropower and thermal generation. The Ente Provincial de Energía del Neuquén (EPEN) is responsible for electricity transmission, distribution and generation services for more than 57,000 customers. It is a decentralized and autonomous entity with 657 employees.

Despite the high electrification rate in the country, there are still 2 million people living in underdeveloped economic conditions in rural areas with no access to sustainable electricity. The remote communities of Cochico and Chorriaca, the locations of our projects, are not connected to the grid and do not have a reliable continuous electricity service, preventing them from improving their standard of living.

RENEWABLE ENERGY

At the national level, Law 26.190 establishes that the development of renewable energies and research in renewable energy technologies and equipment are of national interest. Through this law, the federal government has set a renewable energy consumption target of 8% by the year 2016. The SENER has the power to grant certain tax exemptions, for a period of 15 years, to projects based on renewable energy technologies –such as wind, solar, geothermal, hydropower, tidal and biomass energy and power generation from landfill gas and biogas.

2. Compañía Administradora del Mercado Mayorista Eléctrico."Informe Anual 2011". portalweb.cammesa.com. Compañía Administradora del Mercado Mayorista Eléctrico, 2012. Web. 25 Mar. 2013.

3. Compañía Administradora del Mercado Mayorista Eléctrico."Informe Anual 2011". portalweb.cammesa.com. Compañía Administradora del Mercado Mayorista Eléctrico, 2012. Web. 25 Mar. 2013.

The law also empowers the SENER to increase the fees charged in order to create the Renewable Energy Trust Fund. This Fund subsidizes renewable energy generation. Furthermore, an investment regime was created for the construction of renewable energy technologies.

In 2009, the SENER started to develop the GENREN program. With this program, the federal government has set an objective to develop environmentally friendly energy supplies, reduce greenhouse gas emissions and diversify the Argentine energy matrix. Through GENREN, the government's state-owned energy company, Energía Argentina Sociedad Anónima (ENARSA), calls for bids to purchase renewable energy that will be connected to the SADI.

Renewable energy is encouraged by the Province of Neuquén and supported by laws that promote special tax treatments and business growth. Neuquén's Law 2.596 states that the province is interested in providing electricity through renewable energy sources and in researching renewable energy technologies and equipment. The Provincial Governor's administration is fully committed to GSEP's Patagonia projects, which are aligned with its policies and will produce a direct positive impact on the economically underdeveloped communities of Cochico and Chorriaca.

As part of EPEN's commitment to renewable energy, they have developed the Neuquén wind map, installed and maintained more than 1,200 solar panels for isolated customers and led several energy efficiency initiatives related to public lighting, among other applications.

RURAL ACCESS TO ENERGY

Only 3.9% of the power in the country is generated by isolated power plants (IPP). These IPPs supply communities not connected with the SADI, mostly found in rural areas. However, many remote communities not connected to the grid do not have access to this energy and rely mostly on individual diesel generators that are expensive to operate and maintain, and provide an erratic electricity supply for short periods of time.

Discharge channel of existing grid-connected mini-hydro plant near Chos Malal

House fitted with a solar panel near Chos Malal

The SENER created the Renewable Energy Project in the Rural Market (PERMER) program, which is financed by the federal government and has as an objective to supply power to households in rural areas and to 6,000 public service institutions (schools, emergency rooms, policy stations, etc.) located far from electricity distribution centers. The PERMER also aims to alleviate rural poverty and improve the quality of life of dispersed and remote rural communities. The installation of micro-hydro plants and hybrid wind-diesel generators in small communities, as well as the installation of individual photovoltaic/wind systems, will not only contribute to the availability of a reliable electric service, but also help with the development of small scale economic development projects.

CURRENT SITUATION IN COCHICO AND CHORRIACA

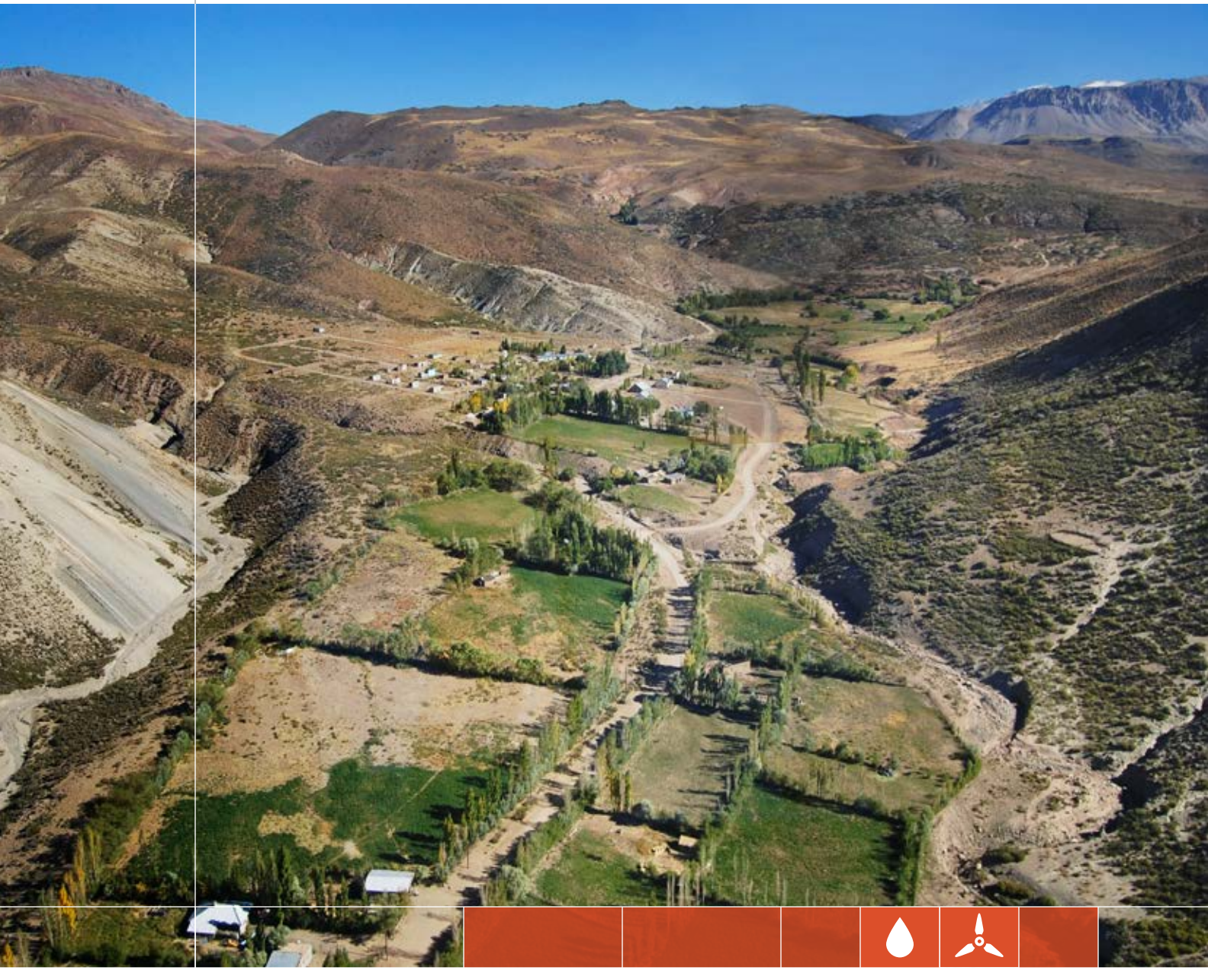
Cochico has a population of 164 (around 20 families), whereas official numbers place the population of Chorriaca at 180 inhabitants. However, according to residents, the community actually has about 500 inhabitants, since they count the surrounding rural areas such as Coihueco, Paso de los Terneros, and Pichaihue, among others.

In Cochico, electricity for residential use did not exist until 2010 when the town authorities requested an electrical generator from the EPEN. The diesel generator operates between 6 to 8 hours/day (between 9.00 am to 1.00 pm in the morning and between 7.00 pm to 11 pm in the evening) during the week and only in the afternoon on weekends. The installed capacity is not able to cover the demand within the functioning schedule. This system of power generation creates environmental concerns because of the handling of large volumes of fuel, the risk of fuel spills and sound pollution.

Some families in Cochico have solar panels that are used for radios and to light their dwellings. Telephone and internet services are available only at the school, and there is no signal for mobile telephone service. Neighbours use Chos Malal Radio and Malargüe Radio for their communications and messages. The Community Health Agent also communicates by radio.

In Chorriaca, the electric service consists of 3 120 kW diesel generators owned and run by the EPEN. The equipment is operated from 7 am to 1 am every day. The installed capacity is enough to meet the demand during operating hours. This generation system causes negative environmental impacts, due mainly to the use of large volumes of diesel, as well as significant noise pollution. Community activities at night need to be previously authorized so as to extend the electricity service, and there is a limit on the number of events held each month. The fuel used by the inhabitants for heating and cooking is bottled gas or zeppelin and firewood from the closest villages of Aluminé and Chos Malal.

The Argentina Patagonia Renewable Energy Projects



Cochico, Argentina

Argentina Patagonia
Renewable Energy Projects

Concept and Objectives

The Argentina Patagonia Renewable Energy Projects aim to provide two remote communities that are isolated from the national grid with access to a sustainable electric service 24 hours a day, 7 days a week. Using local renewable energy sources, the projects feature the design and installation of a 65 kW micro-hydro facility in Cochico and a 75 kW wind-120 kW diesel hybrid plant in Chorriaca. These projects will not only contribute to the communities' social and economic development, they will also displace a portion of the diesel currently used, thereby reducing CO_2 emissions and leading to fossil fuel savings that will be used for the development of other renewable energy projects in the region.

Alhueco creek near Cochico

Project team doing a reading of the wind measurement tower in Chorriaca

INCEPTION

Renewable energy generation in general, and wind power in particular, have been declared of national and provincial interest, to be developed according to the laws and decrees currently in force in Argentina. GSEP's member Duke Energy and its subsidiary Duke Energy Argentina proposed the development of renewable energy projects in the Patagonia region of Argentina. With the strong support of the Neuquén provincial government, we embarked on designing, building and operating –for a limited period of time– a micro hydroelectric facility and a stand-alone wind-diesel plant in the remote rural communities of Cochico and Chorriaca, respectively. Both isolated from the national grid, these communities relied for their electricity needs on diesel units that operated on a discontinuous basis.

To take advantage of the natural resource benefit unique to the Coyuco valley where Cochico is located, a 65 kW run-off-river micro-hydropower plant was designed and built on the Alhueco Creek. By sponsoring the use of local renewable energy as a viable source for electricity, this project in Cochico will substantially improve the quality of life of its residents. Before 2010, electricity for residential usage was inexistent in Cochico, until the introduction of a diesel generator that operated from 6 to 8 hours a day. With the new micro-hydro plant, Cochico residents will have access to a sustainable electric service 24 hours a day, 7 days a week.

Located at the foot of a 50-meter high hill, Chorriaca benefits from constant wind. When demand for electricity in the community, as well as several environmental and technical issues, were taken into consideration, it was found that a wind-diesel hybrid system comprising three 25 kW wind turbines and a 120 kW diesel generator, complete with a hybrid generation control system, would be the most appropriate technology to provide a continuous source of cleaner electricity to Chorriaca.

In close partnership with EPEN, the combined US $2.65 million projects will be a significant step forward in the development of isolated communities by supplying sustainable, clean and diversified electricity through locally available renewable energy sources. A key component of the projects is the allocation of the fuel savings generated by the clean energy production of both facilities to the development of new renewable energy projects in the region by EPEN.

THE ARGENTINA PATAGONIA RENEWABLE ENERGY PROJECTS' GOALS ARE:

- To promote the use of renewable energy;
- To reduce CO_2 emissions by reducing fuel consumption and inefficiencies;
- To transfer technological know-how of renewable energy systems to counterparties;
- To provide a pilot experience for the development of local renewable energy for isolated communities;
- To encourage other power companies to supply sustainable, renewable energy to other communities;
- To promote the importance of developing sustainable, renewable energy as a way to fight climate change and support the social and economic development of otherwise isolated communities.

THE COCHICO MICRO-HYDRO PROJECT BENEFICIARIES

The main beneficiaries of the micro-hydropower plant in Cochico are the residents of the Cochico community. The current diesel generator operates just over half the day. With the new micro-hydro plant, Cochico residents will have access to a sustainable electricity service 24 hours a day, 7 days a week. This will substantially improve their living conditions.

In Cochico, the main fuel for cooking is bottled gas that is bought and transported into the village from the nearest city in Chos Malal. The fuel for the diesel generator must also be transported from Chos Malal. Wood is used mainly for heating. According to the inhabitants, however, there is sometimes a shortage of wood. In winter, minimum temperatures may reach 14° C below zero.

Transportation is seen as a real problem by the inhabitants, in particular in the winter when snowfalls are common. The Provincial Road Agency operates only one machine that clears the road to Puerta Barrancas, the only road out of Cochico, and there is no replacement if it is out of order. In such cases, the only way to get out is on horseback.

Having a reliable electric supply will allow residents of Cochico to light their homes and cook in a safer environment. Access to a sustainable electric service in the winter will prove particularly valuable when daylight time is shorter. The 13-year-old Cochico temporary accommodation school, one of the most important institutions in the village, will be able to provide a continuous service to its 36 pupils. The health care station will also benefit from clean electricity.

"Not having electricity is a problem for those of us who live in Cochico; however, it will be solved shortly. I wasn't confident that this could happen; we waited for such a long time! I consider that having electricity is a very important progress, it is very good. It means development for the population. The children will have easier access to the Internet, everything changes with permanent electricity. Different workshops can be offered, works that require the use of electric tools can be made, have a better equipped first aid room. The way of living will change, no more hand washing, having a freezer would contribute to a different dietary basis, for example. Being able to store fruit, many families don't know something as simple as yoghurt, it is not possible to bring them from the near towns to Cochico. Our diet is based on meat, having electricity would allow us to add more vegetables and dairy products to vary our diet. I am positive; I think the future is going to be much better. I imagine Cochico a bigger place, with more green areas as we will be able to water our parks."

Abelardo, Former President of the Cochico Development Commission

THE CHORRIACA WIND-DIESEL HYBRID PROJECT BENEFICIARIES

The residents of the village of Chorriaca will be the main beneficiaries of a constant source of clean electricity from the newly installed wind-diesel hybrid system. Currently residents have at best a sporadic electric service from 3 diesel generators operated from 7 am to 1 am every day. Not only does this system cause substantial noise pollution to the residents of Chorriaca; but also, the fact that large volumes of diesel need to be transported from the closes villages of Aluminé or Chos Malal poses an important negative environmental threat. Any additional activities that exceed the available electricity beyond the capacity of the generators are restricted. For example, community activities at night need to be previously authorized to extend the electricity service and there is a limit on the number of such events held each month.

Furthermore, residents use bottled gas or zeppelin and firewood for cooking and heating that must also be transported from Aluminé and Chos Malal. As in Cochico, transportation to and from Chorriaca is critical and at times very difficult. Electricity shortages are common due to lack of fuel. This will be eliminated with the new system. Residents will be able to cook and light their houses, as well as connect small appliances, knowing they have reliable electricity.

With the new hybrid system, the health care station and Chorriaca's Primary School Nº 97, with 84 students on its roll, will benefit as well from this electricity service.

"The project is great, the noise from the generator we currently have is going to decrease. The wind energy project will make the town quieter and will bring clean energy. The life of the people will change a lot because we are going to have a lot less noise and there are going to be more projects and ventures from the neighbours. My dream for Chorriaca is that the nearer locations could also have electricity, because they need it as well. I would like my son to stay and make progress in this town and that he gets a job here. Most of our young men have to look for jobs in other places outside our community because here there is not much work. It would be great that other sources of work get here thanks to the electricity. I would like to ask our community to take care of our generator and give good use to it."

Resident of Chorriaca

FEASIBILITY STUDY – KEY RESULTS

Duke Energy Argentina conducted pre- and feasibility studies for GSEP in cooperation with the Neuquén Provincial Government Authorities, EPEN and the local authorities of Cochico and Chorriaca.

The main findings of the feasibility studies are as follows:

- Based on the hydrological, geological and topographical studies of the Alhueco Creek and the Barrancas River sub-basin, the best intake and discharge locations for the Cochico micro-hydropower plant were identified. The studies revealed that the final design of the power plant should be a 65 kW 3-stages Banki-Michell (cross flow) turbine-generator set.
- With this design, the Cochico micro-hydropower plant's annual electricity generation can reach up to 450,000 kWh/year.
- EPEN committed to building a 13.2 kV power line over 4.6 km between the micro-hydropower plant and the Cochico village.
- The Provincial Road Agency offered to improve access to the Cochico project site by building roads and/or extensions where needed to allow for heavy machinery to enter.
- Around eight years ago, EPEN installed wind metering towers across the province to collect wind data. Chorriaca is equipped with one of these wind masts that provides an excellent and steady source of wind measurements needed for the project.
- Several design combinations for the Chorriaca hybrid system were evaluated during the feasibility studies. The final design selected is a hybrid system that includes three 25kW wind turbine generators coupled with a 120kW high efficiency diesel generator that will supplement the wind production when necessary.
- With this design, the Chorriaca wind-diesel hybrid system can produce up to 188,000 kWh/year for the first year of operations, which represents up to 44% of the total demand.
- EPEN agreed to ensure that the savings from fuel displacement (after O&M costs) from both projects will be re-invested in the development of new renewable energy projects in the Neuquén Province.
- A first estimate of the net cash flow generated from the fuel savings is around US $68,500/year for the Chorriaca power plant only. For the Cochico power plant, it is estimated at around US $137,000/year
- Complete social and environmental impact assessment studies were conducted for both project sites to identify potential issues during construction and operation and mitigation measures where necessary, and to obtain the proper licenses.
- The feasibility studies and detailed engineering assessments confirmed the technical, financial and environmental feasibility of both the micro-hydropower and the wind-diesel hybrid projects.

SOCIAL AND ENVIRONMENTAL IMPACT ASSESSMENT STUDIES

The social impact assessment studies were conducted to confirm the social acceptability of the two projects. Conducted with the assistance of a sociologist in close consultation with the beneficiary communities, the studies showed the need to promote socio-economic development for the younger generations and increase the welfare of the population. In Chorriaca, the studies confirmed the high social acceptability of the project, highlighting the fact that, despite having adapted their lifestyles to the limited availability of electricity during the day, the population regarded the use of wind power as ideal. Further, they confirmed that it would result in a permanently high positive impact on the community. In Cochico, the studies also concluded that the installation of the hydroelectric power plant would improve the quality of life of the population, and would give them the possibility of starting other productive and service activities essential to the town.

Additionally, GSEP conducted a complete environmental impact assessment study for both projects to identify potential issues during the construction and operation of the projects, and what measures were necessary to mitigate them and obtain the proper licenses. Given the civil work involved in the development of the Cochico Micro-hydropower project, the environmental impact assessment study was an important aspect. The micro-hydropower plant is located approximately 5 km away from the Cochico village. This area is mostly used for pasture. The Environmental Management Plan (EMP) for the project includes land and water protection measures that will restore the area after completion of the work, namely through replanting of local vegetation to protect the slopes and the creek banks from erosion.

In Chorriaca, the wind-diesel hybrid generating facility is located next to the village. While the wind turbine-generators will be located on the top of the hill nearby, the new diesel unit and the control system will sit next to the existing diesel power plant. The new diesel unit and hybrid control system will have an enclosure built around them that will substantially reduce noise levels from the generator. This will mitigate the noise pollution that currently affects the population and local fauna from the operation of the existing diesel units. The design of the wind turbines was also taken into account in the studies. By using a single pole-type guy wired tower, as opposed to a regular tubular tower, the footprint of the concrete structure of the wind turbines will be reduced and the impact on local vegetation in the medium and long-term will be much lower. Measures were taken to decrease the negative impact on local fauna during the construction phase by limiting the amount of machinery used and its traffic to and from the site. The studies also determined that no major bird migratory paths would be affected by the wind turbines.

Duke Energy Argentina representatives speaking to a Cochico resident

Chorriaca residents attend a community outreach meeting for the project

Argentina Patagonia
Renewable Energy Projects

Project Management

The Argentina Renewable Energy Projects was backed by a team of dedicated professionals that managed the projects from inception to commissioning. With strong support from Duke Energy and its subsidiary Duke Energy Argentina, as well as from the Provincial Government of Neuquén, the community authorities, community members and main partner EPEN, the project team was able to properly execute and manage all the various aspects of the project.

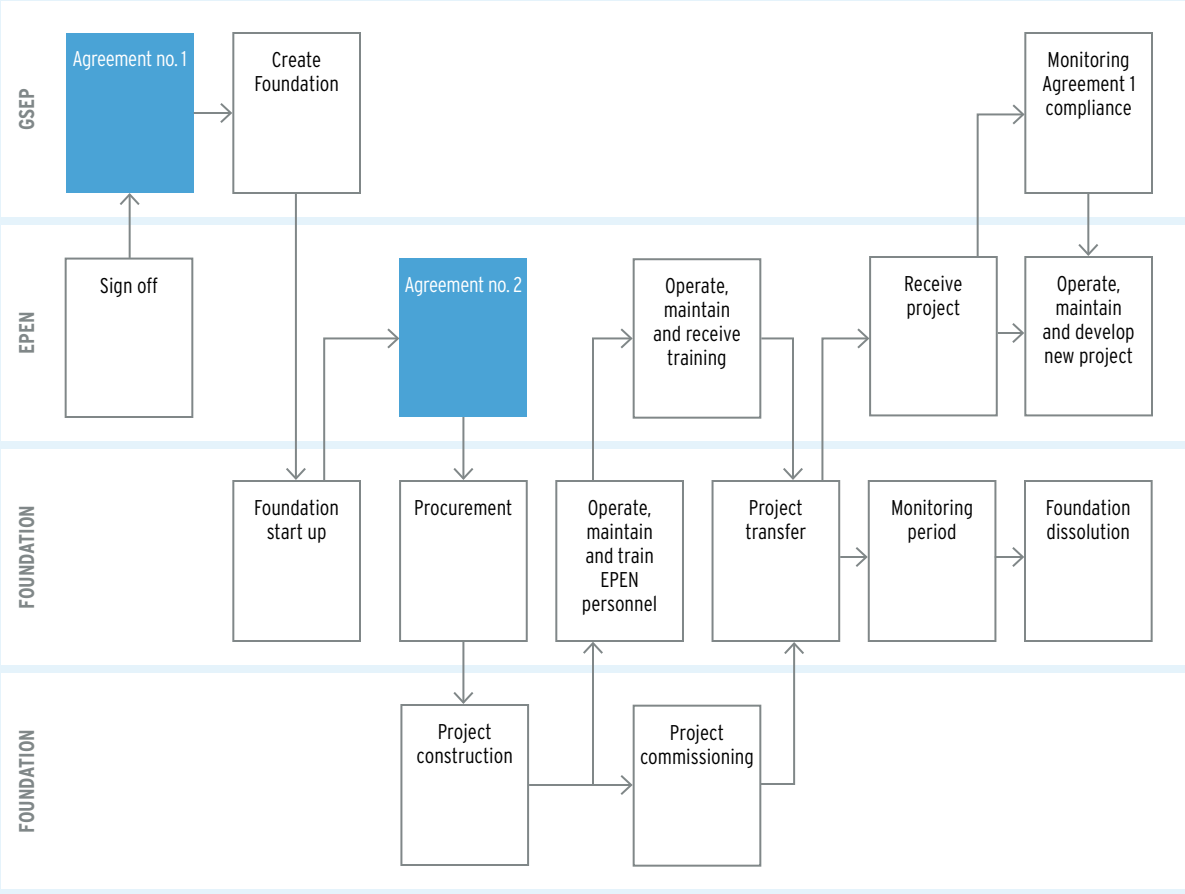
The Argentina Patagonia Projects team, with representatives of Duke Energy and GSEP General Secretariat

PARTNERS AND OVERALL MANAGEMENT SYSTEM

Management of the project was handled by Duke Energy's subsidiary, Duke Energy Argentina with the support of GSEP. To facilitate management of the projects, as well as their implementation, and to coordinate the contribution of participating GSEP member companies, GSEP created the Fundación Energía Renovable Patagónica (FERP), a not-for-profit foundation responsible for managing and executing day-to-day project activities. Through FERP, the Project Manager and the Project Team assigned by Duke Energy Argentina have executed all the necessary steps from the project's inception to its commissioning.

Our local partner is EPEN, the local utility and distribution company. Two agreements were signed between GSEP and EPEN. Agreement no. 1 includes a description of the roles and responsibilities of the parties for the implementation stage until the plants' start-up. Agreement no. 2 defines the conditions for the Operation and Maintenance (O&M) of the power plants by EPEN and the transfer of ownership of the assets to EPEN after the first two years of operation. The process established also sets the conditions under which the training and monitoring, as well as reporting, are conducted. Below is a flow chart that outlines the processes and responsibilities associated with GSEP, FERP and our local partner EPEN.

PROCESS FLOW



It is expected that FERP will be dissolved once the monitoring period (a total of 5 years after commissioning) is completed. However, the Agreements between GSEP and EPEN extend beyond the first five years of operation and cover the entire life cycle of both power plants. During this time, EPEN is committed to re-assigning fuel savings to the development of other renewable projects in the Province of Neuquén.

GSEP recognizes that the strong support provided by EPEN and the Provincial Government of Neuquén have proven indispensable for the development and commissioning of the projects.

FINANCIAL DESIGN

Under the leadership of Duke Energy, which committed considerable financial, material and human resources to the projects, this GSEP investment initiative received generous financial and in-kind contributions from several GSEP member companies: American Electric Power, Hydro-Québec, JSC RusHydro, ENEL, RWE, and Eletrobras. The totality of the capital investment needed for the development and construction of the two projects was raised by these GSEP member companies, and will be graciously transferred to EPEN after two years of operations.

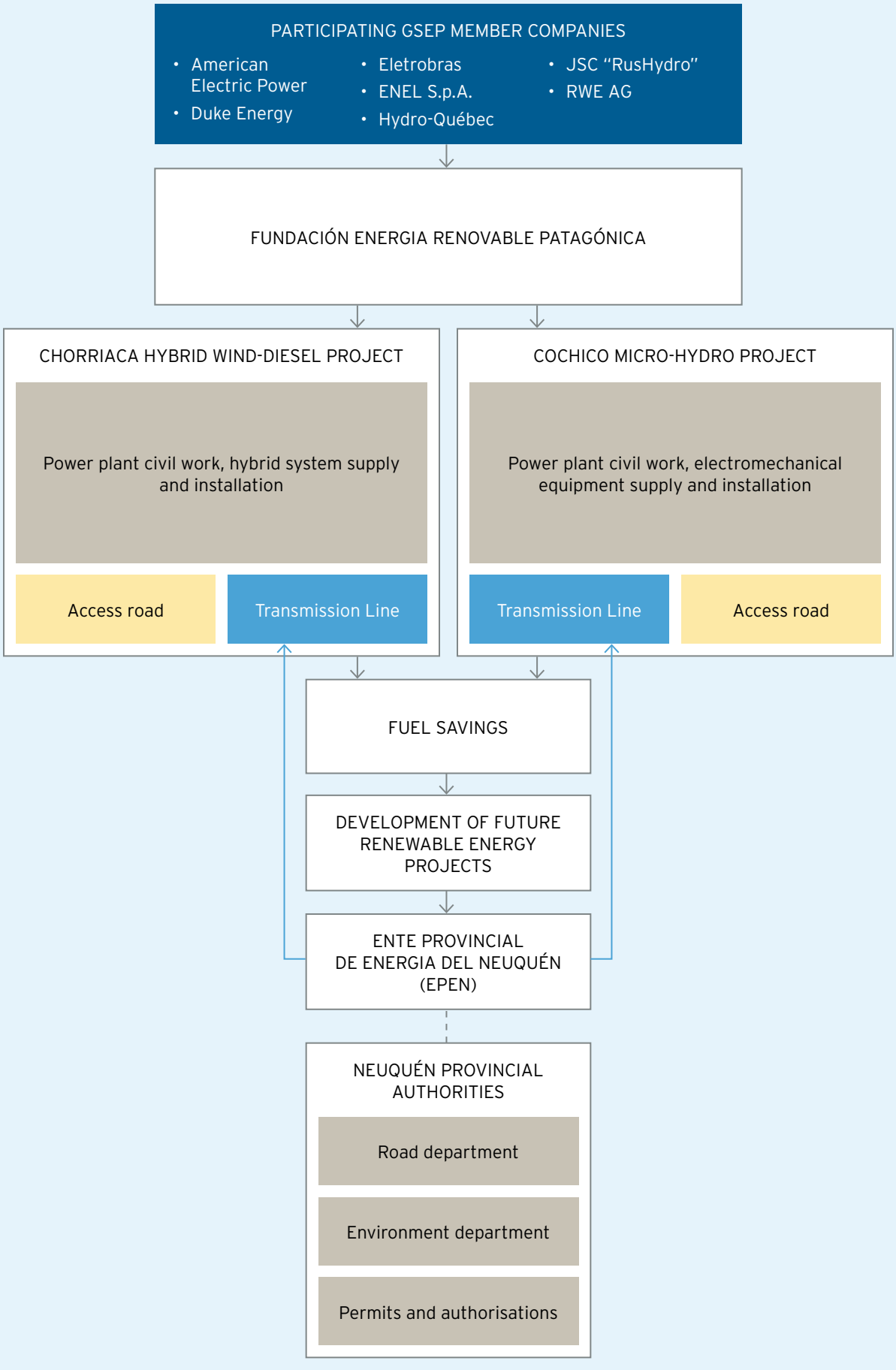
The Neuquén Roads Office financially supported the preparation and maintenance of the access roads to the Cochico and Chorriaca generating facilities. Moreover, the EPEN constructed the power lines from the Cochico micro-hydropower plant to EPEN's Cochico distribution grid (4.5 km) and from the top of the Chorriaca hill to the existing thermal plant in Chorriaca (400 m long).

A key component of the financial scheme is to promote the scaling up of renewable energy projects in the region. Under the agreement signed by GSEP and EPEN, EPEN is committed to allocating the fuel savings generated by the clean energy production of both Cochico and Chorriaca projects to the development of new renewable energy projects. A special fuel savings calculation formula was designed and agreed upon accordingly.

Members of the project team analyzing project figures

Flags of participating GSEP member companies' countries at the Chorriaca groundbreaking ceremony

THE ARGENTINA PATAGONIA RENEWABLE ENERGY PROJECTS FINANCIAL SCHEME



Argentina Patagonia
Renewable Energy Projects

Project Implementation

Designed to take advantage of the natural resource benefit that is unique to each community, the Cochico Micro-Hydro and the Chorriaca Wind-Diesel Hybrid Projects went into implementation in mid 2012. Despite each project having its own implementation schedule and design, the same project team led the development of the projects until the beginning of the operation and maintenance services by EPEN. The groundbreaking ceremonies for the Chorriaca and Cochico projects took place on December 5 and December 6, 2012, respectively. The ceremonies were attended by Governor Jorge Sapag of the Province of Neuquén, government officials, leaders of the region's indigenous communities, representatives from GSEP and Duke Energy, community teachers and students, the project team and families of the beneficiary communities.

Groundbreaking ceremony in Chorriaca with representatives of the project team and EPEN, as well as Chorriaca's Development Commission President and Neuquén's Provincial Governor

Neuquén's Provincial Governor opens the groundbreaking ceremony in Cochico

COMMUNITY OUTREACH

A key factor in the success of any electrification project is the gathering and assessment of the reactions of beneficiaries to the project before and throughout its implementation. Keeping beneficiary communities aware of the project's main development phases through well organized community outreach sessions is extremely important.

During the early inception stage, the Argentina Renewable Energy Projects' team organized a mission to meet with community leaders. With the assistance of its partner EPEN and a sociologist familiar with the communities of Chorriaca and Cochico, the outreach session served to discuss the concepts of using renewable energy to provide a continuous electrical service to the populations, secure the communities' interest in developing new ideas to support local economic development, and address any questions or concerns.

A second community outreach mission was organized in collaboration with EPEN to explain the technical and logistical aspects of the actual implementation phases of both projects. All members of the communities were invited as the project team and EPEN explained the expected outcomes, the communities' role and involvement in the projects, such as manpower needs, and interest in employment, accommodations, and the impact of the construction activities.

These community outreach activities helped gain the trust of the beneficiary communities. A testament to this was the impressive turnout at the groundbreaking ceremony for both projects and the strong presence of the community and local leaders at the inauguration event celebrating the commissioning of both power plants. Well received by the local population, the community outreach events helped create strong ties between the stakeholders and the beneficiaries.

CONSTRUCTION AND SAFETY

Throughout the implementation of both projects, the personnel adhered to the strictest safety standards. Training was provided to ensure that all construction involved was done in a safe manner. The community outreach meetings also served to educate the beneficiaries about safety during the construction stages, such as keeping away from the construction sites and large machinery.

In Cochico, where the largest civil works were carried out, periodic safety meetings were held with the construction crew and communities. In the case of Chorriaca, safety meetings were carried out at the beginning of each project stage, such as during the beginning of civil works, the mounting of the wind turbines, etc. Moreover, staff from Duke Energy Argentina's Environment, Health and Safety department visited both sites to ensure safety standards were respected throughout the implementation stage.

THE COCHICO MICRO-HYDRO PROJECT – IMPLEMENTATION

The construction of a hydropower plant needed to be carefully planned. The installation of large structures such as the intake weir, power house, head race and penstock required taking into consideration not only the actual construction details, but also the building of access roads. Challenges arising from weather conditions at the site – in particular heavy snowfall and probability of rain – needed to be addressed. Another important consideration was the complicated geological characteristics of the site. Due to an unexpected discovery that the surface soil was unstable and could suffer from rotational slides, the site selected for the weir had to be changed during the detailed engineering stage. This necessitated the selection of a new site and redesign of the weir, intake and penstock from scratch. Another key issue was the delivery of the necessary equipment and materials to build the micro-hydropower plant. Given Cochico's remote location and the difficulty of accessing spare tools and materials, any delay could have had a significant and costly impact on the subsequent work, and might have shifted the construction window by several months.

On May 8, 2013, an official delegation from GSEP joined the project team, the local leaders of Cochico, the Governor of the Province of Neuquén and representatives from EPEN to celebrate the inauguration of the Cochico micro-hydro power plant.

COCHICO PROJECT IMPLEMENTATION SCHEDULE

Pre-feasibility Study and Feasibility Study, including social and environmental impact studies	July 2010 to May 2012
Procurement	March 2012 to November 2012
Site mobilization, civil works, detailed engineering, construction of access road, installation of turbines, generator and all electromechanical equipment	November 2012 to April 2013
Transmission line installation including contract selection, issue of permits, etc.	March 2013 to April 2013
Commissioning of Cochico Micro-hydropower Plant	May 2013

Cochico mini-hydropower plant under construction

COCHICO PROJECT DESIGN AND SITE

The design and site selection for the Cochico micro-hydropower project were completed taking into account the village's demand for electricity, as well as hydrological, topographical and geological considerations. The project site selected coincides with a terrace of alluvial deposits virtually free of active landslides. Neither location, the intake or powerhouse, shows evidence of earth movement. The powerhouse is located approximately 5 km away from the Cochico village. The Provincial Road Agency offered to improve the site's access roads and build road extensions where needed to access the power plant site with the heavier machinery.

The final project design takes into account these characteristics. A 65 kW 3-stages Banki-Michell (cross flow) turbine-generator set was installed, with a net head of 20 meters and a maximum turbined flow of 0.51 m3/s. The water will run 460 meters through buried PVC and steel (short-length) head race-penstock pipes of 600 to 500 mm in diameter. Downstream, the powerhouse is next to the creek where the water is discharged after being turbinated to produce electricity.

With this design, annual electricity generation from the micro-hydropower plant can reach on average 220,000 kWh/year. Given its distance from the village, a power line was needed. Our partner EPEN committed to build the 13.2 kV – 4.6 km power line between the micro-hydropower plant and the Cochico village.

THE COCHICO MICRO-HYDROPOWER PROJECT

Maximum Output	65 kW	Maximum Discharge	500 l/s
Net Head	20 m	Annual Electricity Generation	Avg of 220,000 kWh/year

COMPONENTS	
Diversion Weir	Gabions and concrete structure. Total Width: 16 m, height: 5 m, including an 8.6 m Wide X 15 m Long Concrete Central Spillway.
Intake	Side intake
Settling Basin	2 m Wide × 10 m long × 1.8 m Deep
Headrace/Penstock	460 meters buried 600 and 500 mm Diameter PVC pipes, with a short steel penstock section to the powerhouse
Powerhouse	5 m wide × 6 m long × 4 m high – Concrete
Turbine and Generator	3-stage Banki-Michell Cross Flow runner with synchronous type generator

COCHICO CONSTRUCTION AND INSTALLATION

Construction at the Cochico site started with the Engineering, Procurement and Construction (EPC) contractor site mobilization in September 2012. A separate contract was also awarded to an Argentinean engineering firm to supervise the site activities. Thanks to the close collaboration and continuous support of local authorities, the Neuquén Provincial Road Agency reconditioned and built the site's access roads in time for construction to begin.

Total construction time was approximately 9 months. The site works included temporary deviation of the Alhueco creek to lay the foundations of the intake structure (weir). The remoteness of the site, combined with limited lodging facilities for specialized workers coming from other parts of Argentina, made construction and installation at the site challenging. This was further compounded by harsh weather conditions. Despite these issues however, the contractor was proactive and provided the necessary additional resources to complete the site work according to the schedule.

COCHICO OPERATIONS AND MAINTENANCE

The Cochico Micro-hydropower Plant was inaugurated on May 8, 2013. Immediately after its commissioning, the operation and maintenance of the power plant will be the responsibility of EPEN in accordance with the agreement signed between GSEP's foundation FERP and EPEN. GSEP will retain the ownership for the first two years of the plant's operation. Thereafter, responsibility for ownership and management of the facility will be transferred to EPEN. Nevertheless, GSEP will monitor O&M activities for an additional three years.

Cochico's plant power house under construction

Works under way for the power plant's intake structure

THE CHORRIACA WIND-DIESEL HYBRID PROJECT – IMPLEMENTATION

Although the implementation of a hybrid wind-diesel plant required fewer civil works and a shorter timeline than a micro-hydropower plant, the project team was mindful of the complexity involved in the technology vendor selection process. Because it was likely that the vendor would be located outside Argentina, the schedule anticipated the possibility of long delays and the need for long lead times such as those involved in the delivery of the hybrid control system, which included transport from Denmark or the importation of the equipment once it reached the Argentine port. The team addressed these issues by relying on special inspection and expediting services to follow the manufacturing, factory inspection and testing prior to the equipment's shipping, and by organizing frequent meetings with the suppliers. This helped keep the timeline in check.

Another important consideration was the proper timing between the project site activities and the manufacturing and delivery of the equipment needed to build the hybrid system. Coordination of all these actions rested on the timely execution of the various project activities such as registering the Foundation as an importer, obtaining the permits for importation, coordinating with the carrier, etc.

CHORRIACA PROJECT IMPLEMENTATION SCHEDULE

Pre-feasibility Study and Feasibility Study, including social and environmental impact studies	July 2010 to May 2012
Procurement	March 2012 to November 2012
Civil works, including detailed engineering	March 2013 to October 2013
Installation of wind turbines	September 2013 to November 2013
Installation of hybrid system	November 2013
Commissioning of Chorriaca Wind-Diesel Hybrid power plant	December 2013

Erection of one of the pole-type guy wired towers in the Chorriaca's wind park

Workers assembling one of the wind turbines on site

CHORRIACA PROJECT DESIGN AND SITE

The final design selected for the Chorriaca project is a hybrid system that includes three 25kW wind turbine generators (WTG) coupled with a 120kW high-efficiency diesel generator that will be used to supplement the wind production when the demand is higher than the wind generating capacity. This will ensure a full supply of electricity under all conditions. The three WTGs are located on the top of a hill not far from the village. They are laid out to optimize their performance in relation to the wind resource. Prior to the installation of the WTGs, EPEN had erected a wind measurement tower on the hill to collect data from 2006 onwards.

The combination of wind and diesel power is modulated through a special control system. Additional features include a dump resistor for wind production in excess of the demand. The diesel generator – hybrid control system stands in the switchyard next to the existing diesel power plant in a separate sound-blocking enclosure, close to the village. This system will ensure maximum use of wind power. Heat from both the diesel engine and the resistor will be dissipated through the same radiator for an optimized design.

The WTGs are mounted on 18 m high pole-type guy wired tower held in place with guy wires. They are also connected to the grid by a 400-meter power line running from the top of the hill to the grid, passing through the hybrid control system to dispatch power upon availability of wind resources or from the diesel generator. The existing diesel units will only be used as back up to the new hybrid system in case of outages after commissioning of the new power plant.

With this design, annual wind penetration could reach up on average 226,000 kWh/year for the first year of operations, which represents up to 44% of the total demand.

THE CHORRIACA WIND-DIESEL HYBRID SYSTEM

Maximum Output	75 kW Wind – 120 kW Diesel	Fuel Savings	50 000 l/year
Wind Average Penetration Factor (Design)	Up to 44%	Annual Electricity Generation	Avg 226,000 kWh/year

COMPONENTS	
Wind Turbine-Generators (WTG)	3 × 25 kW HS Wind Units complete with 4 pole asynchronous induction generators and computer based controllers
Mounting Structure	Guy Wired 18 m high pole-type guy wired tower
Diesel Generator Set (half container enclosure)	1 × 120 kW high efficiency enclosed unit with dual purpose cooling system (diesel engine and overload discharge resistors)
Hybrid Control System (half container enclosure)	Automated Control Cabinet with automatic switching, voltage regulation and protection
Transmission Line	Approximately 500 m of 400 Volt cables running from the WTG to the container next to the distribution station

CHORRIACA CONSTRUCTION AND INSTALLATION

Civil work in Chorriaca was limited to the WTG foundations, the preparations needed for the cabling and connections, and the concrete pad for the hybrid system's enclosure. The turnkey contract included the construction of the site, manufacturing, testing, delivery, installation and commissioning of the complete system. Close monitoring of both the project sites in Argentina and manufacturing activities in Denmark, from where the system was ordered, was required to ensure proper coordination, supervision, inspection, shipment release, delivery, erection and commissioning.

CHORRIACA OPERATIONS AND MAINTENANCE

The Chorriaca Wind-Diesel Hybrid project was commissioned in December 2013. The hybrid system will be operated and maintained by EPEN crews. GSEP will collaborate with EPEN during the first two years of commercial operation to ensure a smooth transfer of responsibility and make sure the responsible crews have acquired the proper operating and maintenance skills and procedures. Following this, EPEN will take full ownership of the facility. GSEP plans to keep monitoring O&M activities for an additional period of 3 years.

Construction team at the Chorriaca wind park site

Argentina Patagonia
Renewable Energy Projects

Human Capacity Building Activities

The proper transfer of know-how and skills, combined with sharing of experiences, is a vital component of GSEP projects. Power infrastructures require considerable investments which must have long life (revenue generating) cycles. We require our projects to be not only well planned and safely built, but also professionally operated and adequately maintained. Both of GSEP's Argentina Patagonia projects feature human capacity-building activities to build local technical know-how.

EPEN operators receive training on the new wind generation electric system

EPEN employees are familiarized with the wind-diesel hybrid system operations on site

TRAINING IN COCHICO AND CHORRIACA

Throughout the construction and implementation of both the Chorriaca Wind-Diesel Hybrid and the Cochico Micro-hydropower plants, local partner EPEN was invited, from the start, to take part in the development activities to become familiar with the technical and managerial components of both projects.

Led by the project team and equipment suppliers, special technical training sessions were organized for EPEN's operation and maintenance staff on both systems. This enabled the future operators of the power plants to gain the necessary skills and know-how to ensure the sustainability of the projects in each community. A combination of in-class tutorials and hands-on training sessions on the new equipment and operation and maintenance procedures was provided. By the commissioning of both plants, this manpower was ready to manage their operation.

It was identified that at least 7 days of training were needed for the 10 operators of the Chorriaca power plant and at least 4 days of training for the 6 operators of the Cochico power plant. Additional training could also be made available during the first two years of operation with the assistance of GSEP, as required by EPEN.

REGIONAL WORKSHOP TO PROMOTE REPLICABILITY OF PROJECTS

In the years to come, GSEP hopes that the Argentina Patagonia Renewable Energy Projects will draw the attention of other interested stakeholders looking to deploy similar technologies and models. The concept, design and operating schemes (such as a fuel saving reinvestment scheme) can be replicated. In the hope that these projects will be the first of many developments, GSEP wants to encourage other stakeholders to fully take advantage of the many renewable resources available in the region.

To spread and increase awareness of the projects and to reach a wider number of potential stakeholders, GSEP is committed to developing and delivering a regional workshop which can be attended by a wide variety of interested organizations and governments. With the support of GSEP member Eletrobras, this workshop is scheduled to take place in the second quarter of 2014, after the successful commissioning of both the Chorriaca Wind-Diesel Hybrid and Cochico Micro-hydro Projects. The workshop will discuss the potential of public-private partnership to scale up renewable energy projects in Latin America. Among the case studies presented will be the development and implementation of the Argentina Patagonia projects and other renewable energy projects and human capacity-building activities conducted by GSEP in Latin America and around the world.

Argentina Patagonia
Renewable Energy Projects

Sustainable Development Footprint

With sustainable development at the heart of our mission, we always take the necessary steps to ensure the sustainability of the projects we complete. As with our other projects, the Argentina Patagonia Renewable Energy Projects were designed, developed and implemented with their short-run and long-run sustainability in mind in order to ensure they leave a positive sustainable development footprint.

Upon completion, we will supervise the operation and maintenance both the Cochico and Chorriaca projects over a period of two years with EPEN. After this period, we will monitor the projects' performance for an additional three years, even though the operation and management responsibility of the project will be transferred to EPEN. Beyond this period, EPEN will share regular reports with GSEP on the projects' operations.

The new Cochico Mini-Hydro Power Plant and its power house

The newly installed wind park in Chorriaca, named after the late Gustavo Vannucci, a committed engineer in the project and in the development of renewable energies in Patagonia

BENEFITS TO THE LOCAL COMMUNITY

The residents of Cochico and Chorriaca will benefit from sustainable sources of electricity with the commissioning of the micro-hydropower plant and the hybrid wind-diesel system, respectively. Better access to a reliable source of cleaner energy will empower these communities to improve their lives. The provision of this electricity will generate opportunities that Cochico and Chorriaca currently lack, making it central to their economic and sustainable development. Local residents will be able to diversify their farming and livestock economy and improve their quality of life. In Cochico, the electricity provided by the hydropower plant will be used to install a hydro pump for irrigation, as well as a water treatment plant for the community. During the community outreach activities, the local leaders pointed out that they are considering developing their business activities by introducing refrigeration facilities for meat conservation and cheese fabrication with the new electricity.

The projects promote regional economic activities by creating jobs for the local population during the construction and operation of the power plants. They also include the possibility of supporting other economic activities from available off-peak energy, such as pumping water for irrigation.

Not only will these projects contribute to the communities' social and economic development, they will also displace a significant portion (average of 152,000 litres/year) of the diesel currently used or projected to be used for a 24/7 electricity service, thereby reducing CO_2 emissions and leading to fossil fuel savings. Noise pollution will also be substantially decreased in both communities.

A boy is all smiles in Cochico

Some of the children in Chorriaca, the community's hope for the future

REPLICABILITY POTENTIAL

To achieve one of GSEP's main goals –promoting greater access to electricity through the use of renewable energy– the long term viability of GSEP projects and the potential to replicate them is a priority.

In the case of the Argentina Patagonia Renewable Energy Projects, GSEP put forward a project implementation concept that will ensure the viable replication of similar renewable energy projects in the Province of Neuquén. A formal agreement was signed with EPEN, committing the provincial utility to reinvest the projects' savings generated by the displacement of fuel (after O&M costs) into the development of new renewable energy projects in the province. The parties developed a model, which calculates the level of savings to be generated, based on fuel prices, and this was incorporated into the agreement. A first estimate of the net cash flow generated is around USD 137,000/year for the Cochico power plant and around USD 68,500/year for the Chorriaca power plant.

Under the signed agreement, EPEN will also be responsible for providing proof that the revenue collected from the electricity tariffs charged for both projects is being invested in developing other renewable energy projects.

EPEN has been actively investigating the potential of renewable energy in the region, in particular of wind energy. EPEN has collected more than five years of wind data over its territory. EPEN has also mapped and ranked a list of hydropower potential in the region. These data banks show that the potential for financially viable renewable energy projects in Neuquén is significant.

To promote the scaling up of renewable energy projects in the region, GSEP is seeking partnerships with organizations that can leverage the expertise gained through the development of these projects and share this expertise with potential investors.

New transmission line built by EPEN to connect the new Cochico power plant to the town

New wind turbine system installed in Chorriaca

LINK TO UN SE4ALL INITIATIVE

Led by United Nations Secretary-General Ban Ki-moon, the Sustainable Energy for All initiative (SE4ALL) aims to mobilize key players around the world in an effort to make sustainable energy for all a reality in 2030. The three main objectives of this initiative are to ensure universal access to modern energy services, double the global rate of improvement in energy efficiency and double the share of renewable energy globally.

These projects are an example of what GSEP does to further the objectives of the SE4ALL initiative. Access to energy, and in particular to sustainable electricity, is central to reconciling development, poverty eradication and climate change mitigation and adaptation. These projects demonstrate the viability of a bottom-up approach to sustainable energy development. The development of renewable energy in remote communities on the basis of selected locally available resources, as was done in Cochico and Chorriaca, can help communities currently isolated from the main grid to raise their standard of living by having access to reliable electricity.

Through our specific commitments and our regular activities we will continue to show our strong support for the UN SE4ALL initiative, aspiring to take on an increasing role in facilitating energy access by 2030 with other organizations ready to take up the call.

A Chorriaca resident rides off with his herd

Cochico and Chorriaca are small communities isolated from the grid in the Province of Neuquén, in the Argentinean Patagonia. Without access to a reliable and affordable source of energy, remote communities are the most prone to poverty and low-quality living conditions. With sheep and goat farming as their main economic activities, both communities relied on diesel units operated on a discontinuous basis to light their villages. The lack of access to stable electricity inhibited their economic development and access to modern education and health services.

The Patagonia Renewable Energy Projects have changed all that by providing them with permanent and cleaner electricity services 24 hours, 7 days a week, a step forward towards improving their social and economic well-being, creating job opportunities and improving their quality of life.

These projects provide a pilot experience for the development of locally available renewable energy sources in isolated communities. With the creation of a financial scheme that allows for the reinvestment of the generated fuel savings in other renewable energy projects in the Province of Neuquén, GSEP demonstrates how two small-scale projects can be the catalyst for greater change.

ABBREVIATIONS AND TERMS

GSEP Global Sustainable Electricity Partnership

EPEN Ente Provincial de Energía del Neuquén, the Neuquén's local utility and distribution company, and GSEP's main local partner

FERP GSEP's local not-for-profit foundation responsible for managing and executing day-to-day project activities

SENER Argentina's Energy Secretariat

SADI The main national electrical grid in Argentina

PERMER Argentina's Renewable Energy Project in the Rural Market program aimed at supplying power to rural households and remote public service institutions

IPP Isolated power plants

Off-grid not connected to the main electrical grid

WTG Wind Turbine Generators

W watt, the unit of electric power

kW kilowatt, equal to one thousand watts

kWh kilowatthour, equal to one thousand watthours

MW megawatt, equal to one thousand kilowatts

GW gigawatt, equal to one thousand megawatts

GWh gigawatt hours, measure of electrical energy equal to the work done by one gigawatt during one hour

www.globalelectricity.org

To see the video for
this project:

For more information:

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