

PROJECT GALAPAGOS SAN CRISTOBAL WIND PROJECT

LOCATION	Ecuador, Galapagos Archipelago, San Cristobal. Lat: 0°53'30.40"S / Long: 89°29'56.19"W
TIMELINE	April 2003 to October 2007: 3 years for agreement, administration and studies, and 1 year for construction.
CATEGORY	GRANTS/CONCESSION in public-private partnership (PPP) (Build-operate-transfer).
TECHNICAL PARAMETERS OBJECTIVES	<p>Construction of a 2.4 MW (3X800 kW WTG) wind park, complete with hybrid wind-diesel control system to hook up to existing diesel power generating units (owned by EEPG).</p> <ul style="list-style-type: none"> • Reduce fuel consumption for electricity generation and associated risk of fuel spills in a very sensitive ecological environment; • Mitigate government expenses (EEPG) related to fuel power generation; • Promote the development of renewable resources for sustainable electricity generation on the Galapagos Islands; • Achieve progressive transfer of know-how to the local utility (2007-2016); • Deploy a self-sustainable business project in PPP; • Protect the birds from the wind power structures and help an endangered bird species on the island (Galapagos Petrel).
PARTNERS & BENEFICIARIES	<ul style="list-style-type: none"> • GSEP member companies; • UNDP/UNF; • Ecuador Energy Ministry; • San Cristobal Municipality / Residents; • ELECGALAPAGOS S.A (EEPG - public local utility).
OPERATOR	EOLICSA, a GSEP created company for the first 9 years (2007-16) of operation.
FINANCE	<ul style="list-style-type: none"> • Total Cost: USD 10,815,000; <ul style="list-style-type: none"> ○ GSEP Capital contribution: USD 5,680,000; ○ Innovative capital financing through tax revenue allocation and special government funds: USD 3,715,000; ○ UNF Grant: USD 420,000; ○ Soft Loans (UNDP and GSEP companies): USD 1,000,000; • No capital reimbursement. Earnings to support O&M and special funds for Bird Protection and Plant Dismantling and/or major overhauls; • PPA between plant owner (EOLICSA) and local electric utility (EEPG). Revenues are sufficient to cover complete O&M, special funds and soft loans reimbursement; • CDM (carbon credits) registered with an approximate accumulated value of USD 135,000 up to July 2013.

**HUMAN
CAPACITY
BUILDING &
TRAINING**

Training local utility staff on hybrid wind turbine-generator and wind-diesel system operation and maintenance. Wind park operators training.

Transfer of know-how in diesel plant Maintenance, environment, health & safety best practices and recommendations for improvements.

Special grid-connected Solar PV project (USD 260 000 GSEP grant) that includes 12 kW of solar panels and controls along with technical training of utility staff as well as school education program on energy efficiency and e-learning.

ENVIRONMENT

- Detailed environmental impact assessment (EIA) and environmental management plan (EMP);
- Endangered Bird Protection Programme;
 - Project siting to avoid bird flight patterns;
 - Reduction of pest destroying Petrel birds' eggs;
- Reduced risk of fuel spills (more than 30% less fuel consumed for power generation) which was the main objective.
- Collaboration with Darwin Foundation and Galapagos National Park authorities;

**DEVELOPMENT
OUTCOMES
AFTER
7 YEARS OF
OPERATION**

From October 2007 to October 2014 the wind park has maintained an average annual clean energy contribution of more than 30% of the total island electricity needs with availability beyond 93%. During this period, the cost savings for the local power utility are in the order of USD 2,500,000 while the wind power company has generated average annual gross revenues of approximately USD 400,000 under a Power Purchase Agreement between our Galapagos Wind Company and ELECGALAPAGOS S.A (EEPG), the local utility company.

The wind turbines system has cumulatively provided over 22 million kWh of energy to San Cristóbal consumers, reducing diesel consumption by a cumulative total of almost 2 million gallons which is equivalent to 18,000 un-emitted tons of CO²; hence reducing risk of spills.

Registered under the UNFCCC Clean Development Mechanism yielding approximately 10,000 Certified and 1,000 Verified Emission Reduction certificates worth approximately USD 135,000.

Concrete data on the workings of a hybrid system (wind-diesel) and on Public-private partnerships.

The petrels' endangered bird protection programme is very successful with an increased birth rate and no birds killed by the wind turbine operation.

SUSTAINABILITY

Revenues are sufficient to ensure sustainability of operation and maintenance and accumulate revenues for special funds. Tariff was based on lower operating costs and tax waivers (not accepted). PPA tariff of USD 0.1282/kWh with no indexation.

For the local utility EEGP, the net saving produced by the switch from diesel fuel to wind is conservatively estimated at USD 0.15/kWh (based on the sum of the price of delivered fuel on the San Cristobal Island and the transformation cost, minus the PPA tariff paid for wind energy).

Although occasionally a concern for special equipment such as Programmable Logic Controllers for the hybrid control system, sufficient spare parts or local spare part distributors/ vendors are available.

Projected Direct Sustainability Impacts

- Number of household connections	N/A Generation only – connection to existing grid
- Total wattage provided by electrification	2.4 MW wind power (in wind-diesel hybrid configuration)
- GHG emission reduced/avoided	<ul style="list-style-type: none"> • 30% diesel displacement (average, actual)- • 2,527 tons/year GHG emissions avoided (average, actual) • 19,947.90 tonnes of CO2 equivalent for the crediting period of 7 years(per CDM PPD) – actual 17,695 tons
- Number of public buildings connected	N/A
- Energy efficiency	N/A (separate DSM initiative being considered)
- Total person days provided in Capital Project	N/A
- Total capital invested (GSEP and external)	US\$ 10.8 million (total)
- Number of HCB training days provided	N/A
- Number of participants who received e7 HCB	N/A
- Computers provided	2
- Internet connection provided	Micro Solar Distance Learning Program
- Telecommunication connections provided	N/A

▪ **Projected Indirect Sustainability Impacts (qualitative description)**

- Facilitated health care	New hospital in San Cristobal Island is connected to the grid being served by the wind project
- Facilitated education	Micro Solar Distance Learning Program
- Facilitated water access/sanitation	Provide off-peak, unutilised wind power to new Municipal Potable Water Facility as DSM opportunity (not pursued)
- Facilitated local entrepreneurial activity	N/A
- Other impacts	Funding and technical assistance to Galapagos National Park Service and Charles Darwin Research Station with respect to the conducting reproductive, flight, and mortality monitoring studies for the endangered Galapagos Petrel.

REPLICATION

- The Government of Ecuador with the help of UNDP and foreign development agencies is now replicating the project on other Galapagos Islands. GSEP has provided the procedures

used for the San Cristobal Wind Park and Hybrid Control System commissioning for the new project

- An inventory of renewable energy sources is available.
- Availability of contractors with sufficient construction supervision skills. Availability of local technical skills though can require tailored human capacity building for specific technology/technical know-how transfer.

KEY SUCCESS FACTORS

- Renewable Energy Incentives including tax waivers and special wind energy tariff designed with the assistance of GSEP to achieve financial sustainability of wind projects;
- Availability of an energy resources inventory;
- Funding diversification (UNDP, UNF, Tax, Grant, GSEP);
- CDM registration;
- The use of a Power Purchase Agreement (PPA);
- Support from local and national authorities;
- Conception of an Environmental Impact Assessment (EIA);
- Small education session on sustainable electricity consumption with students and their families;

OTHER FEATURES

First large scale wind project in Ecuador and one of the world's largest wind-diesel hybrid system in its time.

Innovatively capitalized with funding from UN agencies (UNF and UNDP), Ecuadorian taxpayer donations, the Government of Ecuador, and Global Sustainable Electricity Partnership companies.

World-class, high penetration hybrid system recognized as a model for sustainability, recipient of Power Engineering Magazine, World Energy Forum, and Energy Globe awards.

Listed as a destination for tourists visiting this UNESCO World Heritage Site.

UNFCCC CDM Registered (Carbon Credits)

STATUS

Commissioned in 2007.

Assets to be transferred to EEGP in 2016.

In operation.

Lessons learned report (project development phase) available upon request.

LESSONS LEARNED

- Formation of the Commercial Trust in Ecuador was one of the most critical elements leading to the project success. It served to fire-wall GSEP, allow for legal participation by local utility partner, allow for project control by GSEP for early operating years of the project and exit strategy, provided a legal vehicle for project funding and legal bookkeeping and reporting in Ecuador and to UN.
- Partnerships with UNDP and local utility Elecgalapagos (EEGP), as well as involvement of local stakeholders (NGOs, government ministries, special agencies, local government and general public) were important to increase the project's credibility, increase replicability potential and its long-term success.
- Hiring a respected in-country Local Manager with an excellent knowledge of the electric sector was critical to project development, funding alternatives, navigating the institutional issues, and in project implementation.
- A complex project such as this requires long-term commitment, both prior to starting commercial operations and post in monitoring. Quarterly and annual reports from the project director helped foster trust and transparency between the stakeholders.
- The two-step implementation approach of a Limited Notice to Proceed (LNTP) phase followed by a Full Notice to Proceed (FNTP) phase was effective in mitigating project risk. Despite translating to approximately nine months delay in the project schedule and requiring more active project management, ensuring that key milestones were achieved

before moving forward gave the project team some leverage with local stakeholders and the Government and ensured its long-term sustainability.

- A financial structure with a donation basis allow the project to be development since in the heavily subsidized utility sector and the high cost of a high-penetration wind –diesel hybrid system on a remote island, it would have been very difficult to craft any agreement for the repayment of the original investment.
- The development of a Commercial Trust structure proved to be the best way to go. It was a cost effective approach to have the Trustee provide financial auditing, tracking, and payment of invoices, etc. The Trust also set up special dedicated accounts to set aside funds for specific purposes (petrel fund, dismantling, and emergency repairs), which helped ensure the project was adequately capitalized to support on-going operations.
- Incurring significant legal costs to set up the project structure as well as carefully crafting all legal agreements with local parties were a worthy investment as they help avoid potential issues later in the project that could have created delays and had greater cost impact.
- An early and thorough Environmental Impact Assessment and associated Environmental Management Plan (EMP) were very effective for gaining necessary approvals and confidence of the local stakeholders. It also facilitates long-term monitoring to ensure compliance.
- A Project Execution Plan was helpful in managing the project and giving the GSEP confidence the project team was taking a comprehensive approach to managing the wind project.
- Given the complexity of the Wind Project, the technical requirements needed to be accurately defined and the commercial terms and conditions unambiguous. Well-written and precise contracts with the main contractors were crucial.
- The success of the wind project’s commissioning phase, with relatively few technical problems, was likely a direct result of the significant factory load testing effort. It is suggested that similar factory load testing be pursued for all project intended for remote locations.
- The Operations Manager was trained in Spain at the factory and at an operating wind farm with the same class turbine equipment. The “hands-on” training approach resulted in very capable staff being available on San Cristobal Island to operate and maintain the wind project.
- A two-year O&M Agreement was signed with MADE to service the wind turbines and provide technical support, increasing reliability, availability, and training. The project’s SCADA control system that allows the manufacturer’s technicians to monitor, operate and troubleshoot proved to be a highly effective tool, and this remote monitoring should be considered for other projects in remote locations.
- Additional “remedial” training should be considered earlier in the project for local utility O&M staff, especially for electronics and control systems. Institutional issues and high turn-over of Elecgalapagos management during the project implementation hindered improvement in capacity of local staff.
- Hiring local engineers for on-site oversight and reporting was important and cost effective. The wind project team was able to have representative(s) on site through all phases of construction and operation.

