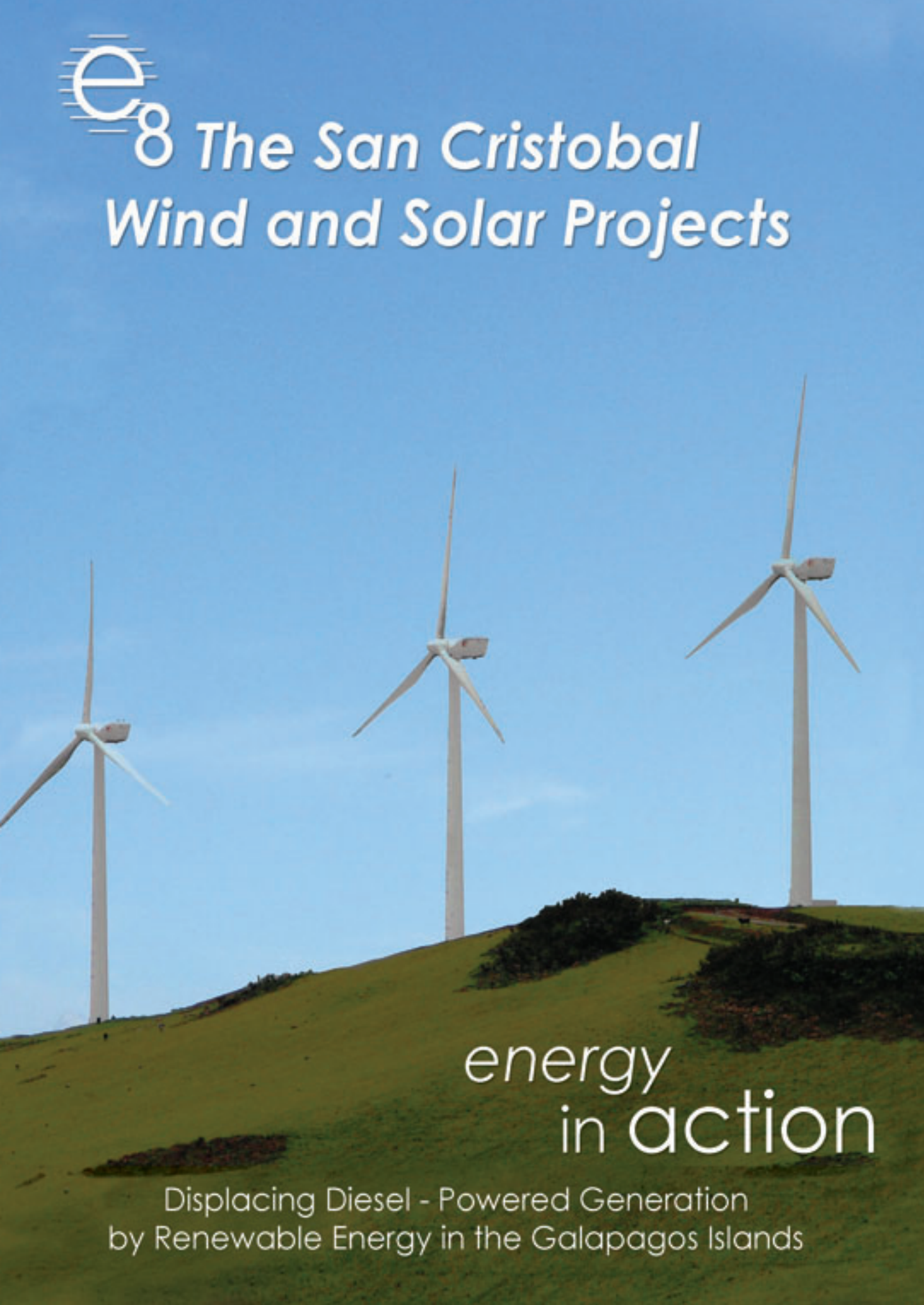
8 The San Cristobal Wind and Solar Projects



energy in action

Displacing Diesel - Powered Generation
by Renewable Energy in the Galapagos Islands

What is the e8?

The e8 is a non-profit international organization, composed of nine leading electricity companies from the G8 countries, which promotes sustainable energy development through electricity sector projects and human capacity building activities in developing nations worldwide.

The e8's mission is: "To play an active role in global electricity issues and to promote sustainable development." This diverse international group offers electricity sector expertise and practical competency in electricity generation, transmission and distribution. With field-proven expertise in the planning, management, design, operation and maintenance of energy facilities, member companies together provide an all-encompassing scope of the global electricity industry to assist developing countries.

e8 Member Companies:

American Electric Power
(USA)

Électricité de France
(France)

ENEL S.p.a
(Italy)

Hydro-Québec
(Canada)

Kansai Electric Power Company, Inc
(Japan)

Ontario Power Generation
(Canada)

RAO-UES of Russia
(Russia)

RWE AG
(Germany)

Tokyo Electric Power Company, Inc
(Japan)

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Message from the e8 chair

The year 2007 has been key for all actors involved in the cause of combating the major global challenge of climate change and its potential grave consequences on human development and the global environment. Science has now clearly demonstrated that urgent and concerted international action is needed in order to reduce global greenhouse gas emissions and mitigate the adverse impact of climate change on the overarching and global objective of achieving sustainable development for all.

The e8, the mission of which has been to promote sustainable development through renewable energy projects and human capacity building worldwide, is proud to inaugurate, this year, a major project, which will not only contribute to the national effort of Ecuador's government and the global efforts to reduce green house gas emissions at large, but will also contribute to the protection of one of the richest and diverse ecosystems of our planet.

The e8 San Cristobal Wind Project, featuring the implementation of a 2.4 MW wind farm on the inhabited island of San Cristobal, in the Galapagos World Heritage Site, will displace diesel-powered electricity generation by wind energy, helping to reduce greenhouse gas emissions and the risk for equally devastating diesel-fuel tanker spills in this highly protected environment.

The Galapagos San Cristobal Wind Project demonstrates that concerted and joined action, local, international, private and public partnerships can effectively contribute, and that they are in fact key, to the global effort needed to address the challenge of climate change, protect the global environment, and achieve sustainable development for all.

Thierry Vandal

Mr. Thierry Vandal
Chief Executive Officer, Hydro-Québec
e8 Chairman for the year 2007-2008

Message from the American Electric Power Chairman

I am very pleased to report to you that the e8 San Cristobal Wind Project is commercially operating after six years of hard work by all the partners. This is an accomplishment that has required continued teamwork between e8 companies since 2001, when the United Nations (UN) asked for the participation of our organization, the e8. During the Fifteenth session of the Conference on Sustainable Development in April 2007, the United Nations showcased the project as a private-public partnership model for other nations and project developers to follow for the advancement of renewable energy development worldwide.

The e8's photovoltaic (PV) solar power operations and maintenance training and student energy efficiency education programs have also been completed this year. These programs complement the wind project by strengthening the human capacity and skills of local utility company workers operating the type of technology introduced by the projects.

The student energy efficiency programme contributes to increasing local citizens' knowledge of and awareness about efficient energy consumption. These three human capacity building and educational programs, along with the major Wind Project developed on the Island of San Cristobal, will help the Galapagos Islands to achieve Ecuador's goal to shift from diesel-based power generation to renewable sustainable energy development.

I am very proud to launch, on behalf of the e8, an unprecedented renewable energy project in the Galapagos, Ecuador, which will contribute to the protection of a unique World Heritage Site, help preserve the biodiversity of an exceptionally rich ecosystem, and be part of the global effort to reduce green house gas emissions worldwide.

Michael G. Morris

Mr. Michael G. Morris
Chairman, President and Chief Executive Officer
American Electric Power (AEP)

Message from Ecuador's Minister of Electricity and Renewable Energy

In a context in which petroleum is becoming a more expensive and scarce natural resource, sustainable energy development raises two basic challenges. One of them is to promote the use of renewable energy resources. The other, perhaps even more important, is to learn to efficiently us the energy available to us.

It is within this framework that Ecuador's Ministry of Electricity and Renewable Energy is looking to develop policies and projects which satisfy the country's short, medium and long-term energy demand, while steadily diversifying the type of generating sources and paving the way for a post-petroleum era.

Wind energy is one of the technically, economically and socially viable forms of renewable energy which can be applied in Ecuador. Nevertheless, it is still a relatively underused resource.

Thanks to the joint efforts of the national Government and the e8 companies, Ecuador has now commissioned its first wind farm, located in San Cristobal Island, in the Galapagos archipelago. The generation of this clean energy has been able to reduce thermoelectricity to 50% on the island, benefiting both its population as well as the ecosystem.

International cooperation allowed this project to be developed within a socio-environmentally responsible policy framework, which recognises the importance of the well-being of the local population and the conservation of its natural environment.

Continuing this line of work, the Ministry of Electricity and Renewable Energy is looking for additional opportunities to take advantage of wind power.

This is the case of other regions in Ecuador with an abundance of wind, which have already initiated studies for potential future projects, like Villonaco and Salinas de Imbabura, and which will need further support for implementation.

Wind energy is seen as a viable alternative because of its ability to replace thermic generation, and can eventually become an important part of the nation's electricity generation park.

Using renewable energy resources also represents a relief to the environment, especially in highly vulnerable environments such as the Galapagos islands. In this sense, renewable energy is consistent with the development ideals of the current generation while it also guarantees the right of future generations to live in a healthy environment.

Alecksey Mosquera

Mr. Alecksey Mosquera
Ecuador's Minister of Electricity and Renewable Energy

1 Renewable Electrification of the Galapagos Islands

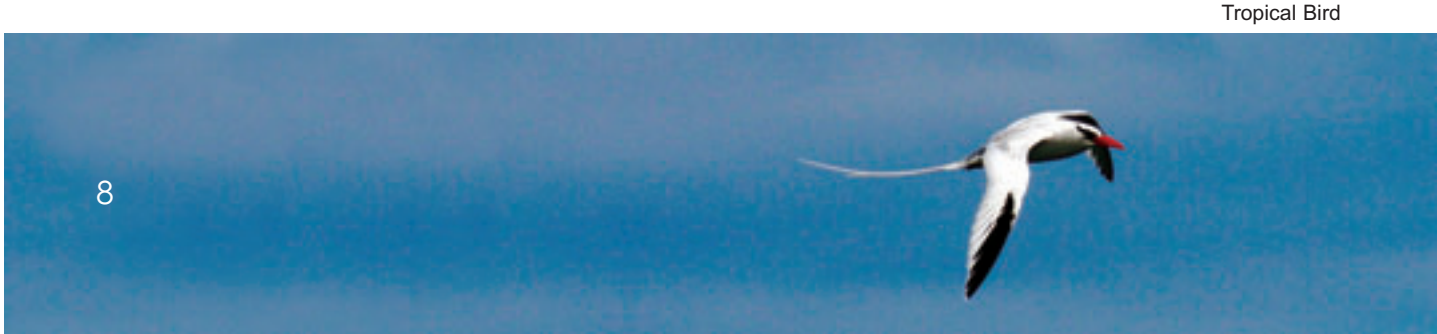
Introducing the e8 Wind Project in the Galapagos

The San Cristobal Galapagos Wind Power Project is part of the Ecuador's Government umbrella program "Renewable Energy for Electricity Generation-Renewable Electrification of the Galapagos Islands" supported by the Global Environment Facility (GEF) and the United Nations Development Programme (UNDP). This program involves public, private, local and international donors to re-electrify the four populated islands of the Galapagos Archipelago. The Ecuadorian Government has contributed to the San Cristobal Wind Project with approximately $ 3.3 million USD to this project.

The umbrella program aims at introducing Photovoltaic (PV) and wind energy as substitutes for fossil fuel (mainly diesel) used for electricity generation in the Galapagos Archipelago. In addition, the program will substantially decrease the volume of diesel annually shipped to the islands, thereby decreasing the environmental threat of oil spills, which can cause great damage to the unique biodiversity of the islands' ecosystems.

The San Cristobal Wind Project includes the provision of technical assistance by the e8 member companies, the experts of which share technical and field-proven internationally diverse expertise on renewable energy development. The San Cristobal Wind Project is a partnership between the Government of Ecuador, the United Nations Development Programme (UNDP), and the San Cristobal Wind Project Commercial Trust (FIDEICOMISO MERCANTIL PROYECTO EOLICO SAN CRISTOBAL). The founders of the Fideicomiso are member companies of the e8 organization(American Electric Power-AEP and RWE) and the Galapagos Electricity Utility (Elecgalapagos) is an Adherent and Beneficiary of the Trust. The project is designed to replace, as much as technically and economically feasible, the existing diesel combustion-generated power in the San Cristobal Island with a clean energy source based on wind turbines, with the dual objective of reducing greenhouse gas emissions and minimizing the environmental risks associated with the current power generation system. The 2.4 MW wind project in San Cristobal, operating in hybrid fashion with the existing diesel generator units, will provide approximately 50% of the island's annual electricity demand for energy.

Tropical Bird



The e8 Galapagos San Cristobal wind project is:

- The first large-scale wind project in Ecuador (Three (3) 800 kW turbines for total installed capacity of 2,400 kW).
- A six-year project with an approximate cost of $10 million USD.
- Complemented by two (2) 6 kW Solar PV systems, solar PV technical training and energy efficiency educational programmes.
- A wind project built on a UNESCO World Heritage Site, as a component of the Ecuador's renewable energy program for the Galapagos Islands supported by the United Nations Development Programme (UNDP).
- One of the largest wind-diesel hybrid systems in the region, supplying more than 50% of the island's electric needs through wind power.
- Featuring a programme for the protection of an endangered indigenous bird specie (Galapagos Petrel).
- Registered under the Kyoto Protocol's Clean Development Mechanism.
- A non-profit wind project implemented under a new and unique public–private partnership trust.
- A project based on an innovative financing structure, including funding from UN agencies (UNF & UNDP), Ecuadorian taxpayers'donations, the Government of Ecuador and e8 companies.

San Cristobal Wind Park at El Tropezon

Nearly 300,000 years old, Fernandina is the youngest island in the Galapagos archipelago

Protecting a World Heritage Site

Ecuador: A Country of Rich and Unique Biodiversity

Ecuador occupies only 0.17% of the Earth's surface, but is home to more than 11% of all land vertebrate species, 16,087 vascular plant species, and around 600 species of marine fish.

The contrast between this country's natural abundance and size never ceases to amaze its own people and foreign visitors. Ecuador is on the United Nations Environment Programme's list of the world's 17 megadiverse countries, which has attracted the attention and interest of millions of people worldwide.

Ecuador prides itself on the multi-ethnic and multicultural nature of its population of 12.6 million. Fourteen indigenous nationalities spread over the Sierra, Coast and Amazon regions make up a unique mosaic of traditions and cosmovisions. The capital city of Quito alone is a moving showcase of this impressive diversity. The same is certainly true for Guayaquil, the country's main port and economic driving force.

This Andean country enjoys unique geographic conditions, which make it particularly attractive. Located on the Tropic of Cancer, the Andean Cordillera crosses it from north to south; warm damp sea currents from the north merge with cold dry currents from the south on its continental and island coasts, contributing to the unique geographic and climatic characteristics behind the country's natural wealth.

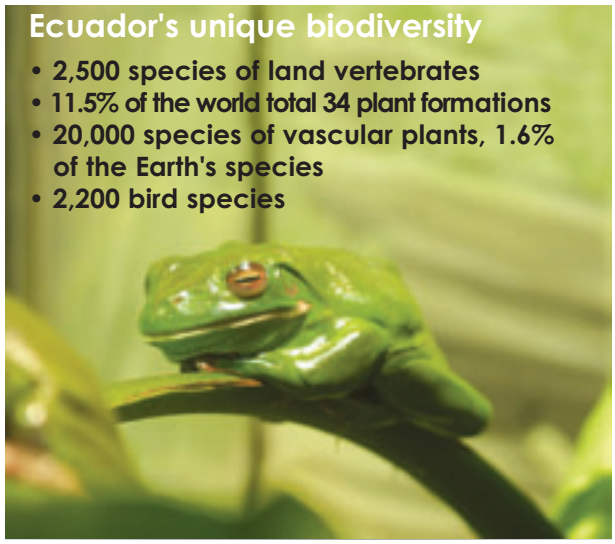
Ecuador is divided into three continental regions – the Coast, the Highlands and the Amazon – as well as an island region, the Galapagos, each with its own distinct geographic and cultural characteristics.

The presence of the Andes Mountains gives the country a varied climate despite its location in the tropical Zone along the equator. Ecuador possesses a wide altitudinal range that extends from sea level to 6,310 meters (at the summit of the country's highest mountain, Chimborazo).

This altitudinal variation, combined with winds coming from the Amazon and the Pacific Ocean, nurture over 36 types of vegetation, including tropical humid forests, cloud forests, paramo grasslands, and dry forests. Despite its small size, Ecuador has more bird and tree species than the significantly larger territory of the United States.

Not only does Ecuador possess an amazing wealth of biodiversity, but it is also home to a wide range of cultures. The presence of Quichua, Huaorani, Chachi, Tsáchila, Cayapa, Puruhae and Tagaeris indigenous groups, along with mestizos, Afro-Ecuadorians and whites, has been at the core of the rich multiethnic Ecuadorian cultural identity.

The recent migratory movements out of and into the country have further contributed to Ecuador's rich an complex demographic makeup. Today, remittances from emigrants constitute Ecuador's second largest source of income after oil production.



Quito, San Francisco Church and Square

Chimborazo, Ecuador's highest peak at 6310 m.

Guayaquil, main port of Ecuador

Ecuador's Galapagos Islands

The Galapagos archipelago is Ecuador's best known face to the world. Graced with an extraordinary natural beauty, a unique endemic biodiversity and scientific importance, this archipelago is unique on the globe.

Located in the South Pacific, 1,000 kilometers away from the American continent and below the equator, the Galapagos islands are world renowned for the vital role that one of their species, "the finch", played in the revolutionary Theory of the Evolution of the Species, developed by the English naturalist Charles Darwin in the nineteenth century.

Today the Galapagos continues to offer an exceptional environment for the scientific study of evolution, being the world's best conserved oceanic archipelago, with 95 percent of their original flora and fauna still intact.

Comprised of 13 large islands and 112 small islands and islets, the archipelago belongs to the Republic of Ecuador. Its land surface is 8,000 km², 96 percent of which consists of protected areas. The Galapagos has one of the world's largest and best conserved marine reserves, encompassing a 138,000 km² surface area, which is home to a significantly diverse and extraordinarily wide range of biological species.

Several theories have been proposed to explain the origin of the land species in the archipelago. However, the only certainty about the uniqueness and endemic biodiversity of the Galapagos' fauna is that geographic and genetic isolation forced species to change and adapt to the diverse ecosystems of these young islands.

The environment of the Galapagos led its wildlife to evolve in specific and unique ways. One bird species, over hundreds of years, stopped flying, eventually evolving into the only flightless cormorant that exists today.

The Galapagos continues to offer an exceptional environment for the scientific study of evolution

One of the islands' reptiles learned how to dive for food and became the only lava lizard that feeds under the water. Land birds, such as the finches, adapted their beaks in order to be able to reach their preferred diet, thus giving rise to the mangrove, cactus and woodpecker finches and 10 other subspecies found in the archipelago.

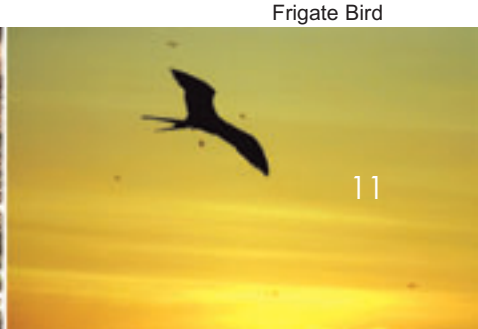
Another notable aspect of the Galapagos is associated with its constant state of formation. Its volcanic origin continues to manifest itself. In fact, the islands are the peaks of underwater volcanoes. In the last 37 years, Isla Fernandina, the youngest island in the archipelago (born approximately 300,000 years ago), has recorded 14 eruptions.

The much celebrated levels of endemism (proportion of species that are only found naturally in a particular space) in the Galapagos are part of the fascination the archipelago holds for scientists, tourists, the Galapagos community and the world at large. Its emblematic flora and fauna include the giant tortoises, marine iguanas and the fur sea lion, as well as 229 plants and 51 species of fish.

Hammerhead Sharks

Giant Tortoise

Frigate Bird



It is notable that the islands' ecological value and the state of conservation of its ecosystem have made the Galapagos the recipient of several international distinctions, including their being named a Whale Sanctuary, Biosphere Reserve, and listed as RAMSAR Site by the inter-governmental convention on the conservation of wetlands (The RAMSAR Convention on Wetlands).

Galapagos skate fish

Underwater treasure

The Galapagos Marine Reserve is one of the most productive and biogeographically complex areas on the planet. Developed to protect the waters surrounding the archipelago and its fascinating, rich and diverse ecosystems, the Galapagos Marine Reserve (GMR) was created in 1998.

Tropical, subtropical and sub-Antarctic currents converge in the GMR, creating conditions that enable organisms from a wide range of geographic origins to coexist in its waters.

The waters of the archipelago contain an extraordinary number of biological communities including penguins, tropical corals, hammerhead sharks among thousands of other species. The GMR contributes to the coastal life of the Galapagos National Park (GNP), where marine iguanas, cormorants, lava gulls, sea lions, boobies and other species find their daily sustenance. The islands also play an important role in the migratory routes of pelagic species such as marine turtles, whales and dolphins.

Home to 30 species of sharks and approximately 2,900 species in total,18% of which are endemic, the GMR was decreed an area of strict environmental protection. While the islands' optimal diving conditions are one of their main attractions, both fishing and tourism activities are strictly regulated and limited.

Descending into its depths, one enters into a colorful and constantly changing landscape of coastal platforms and seamounts. Phytoplankton, zooplankton, the whale shark (the largest fish in the world) and the Pacific green sea turtle all cross the GMR in perfect harmony.

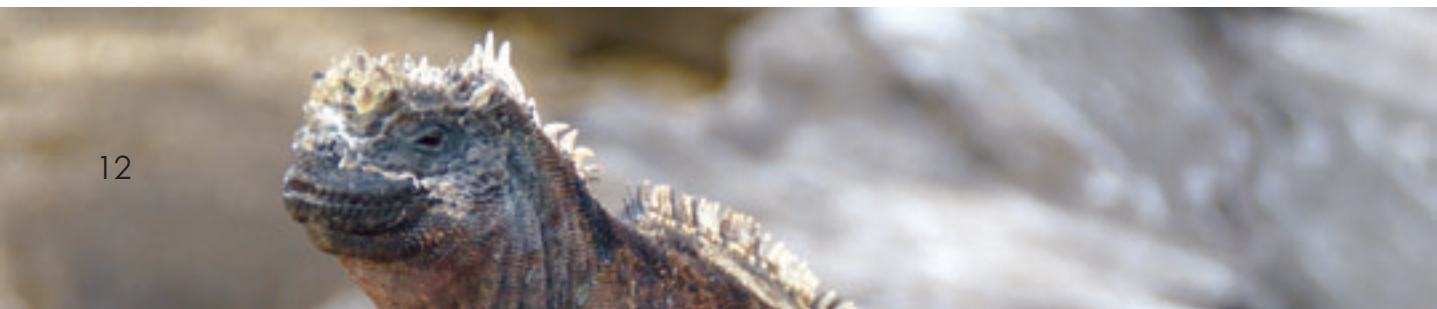
Land Species

The Galapagos' appeal does not end behind a diving mask or snorkel. The nearly 8,000 km² of protected area are a constant source of wonder. The islands' strong volcanic nature, in which rock and vegetation merge, sustain land life for a unique variety of species.

In the diary of the journey that brought him to the Galapagos aboard the Beagle, Darwin himself delightedly described the whimsical shapes the lava took as it turned to rock as "beautifully symmetrical". He also noted the contrast between the low and high zones, the climatic differences and the rather dry environment, and depicted the islands' vegetation as "tolerably luxuriant".

Opuntia (prickly pear) cacti and escalesias sprout among the rough lava flows while new life springs up around them in habitats

Galapagos sea iguana



that shelter geckos, cucuves, escolopendras, lizards and finches, all with unique characteristics holding the secrets of life and evolution.

According to some theories, the two main factors, which likely caused the Galapagos species to evolve differently from their relatives in the rest of the world, were the abundance of food and absence of natural predators. Beyond its biological diversity, the archipelago is mostly known for its significantly high levels of endemism. Almost all of the Galapagos' flora and fauna, with their distinctive characteristics, can only be found naturally in the islands, making the Galapagos Archipelago, like most of its inhabitants, unique and distinct from any other ecosystem.

An overview of the Galapagos cannot come near to covering all there is to say about such a unique natural environment. Millions of years of evolution, with almost all of its secrets still intact, are not so easily understood or told.

Thousands of species, including finches, tortoises, frigate birds, iguanas, opuntias, sealions, matazarnos and boobies, are still waiting for someone to tell their stories.

San Cristobal Island – Chatham

In 1790, when the whaling business crashed in a world-wide crisis, the Galapagos islands became a new exploratory destination for whalers around the world. In 1793, Captain James Colnett, heading an English fleet, arrived to the archipelago to study the possibilities of establishing a whaling station in the South Pacific. Captain Colnett re-drew an accurate map of the archipelago and re-named some of the Islands, and among them San Cristobal, until then known as Chatham.

The XVIII (1835) Century brought captain Robert FitzRoy on board of the *HMS. Beagle* to the Bay of Chatham, with his fellow traveler, Charles Darwin.

At anchorage, the crew of the *Hms. Beagle* was happy to observe, swimming along the ship, a wide variety of tropical fishes together with sharks and sea turtles.

Admiral Villamil, by then Governor of the islands, had named Lawson (an unknown Englishman) as his Deputy. Lawson greeted the *HMS. Beagle* travelers and by making a comment on how the physical features of the giant tortoises diverge, triggered in Darwin the feeling that the place held unique potential for scientific research.

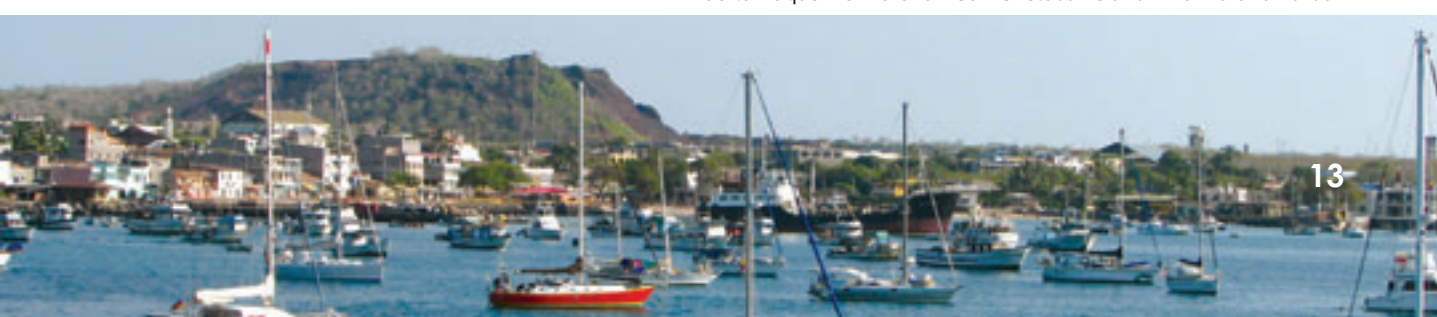
San Cristobal in its own way has never stopped being Chatham even when its name officially changed in 1892. The presence of pirates and whalers, characteristic of the 18th Century, and the mystery and harsh reality of these turbulent years of Chatham can still be felt on the streets of Puerto Baquerizo Moreno today.

Puerto Baquerizo Moreno

With its approximately 6,142 inhabitants (INEC-2006) and its 558 square kilometers (85% of which belong to the National Park), Puerto Baquerizo Moreno is the Galapagos province's capital and its second largest town, preceded by Puerto Ayora in Santa Cruz.

Today, in Puerto Baquerizo Moreno, previously known as Puerto Chico, fishing remains the dominant economic activity of the island. San Cristobal holds the largest fishermen population of the archipelago. According to the Galapagos National Park Service, 1006 artisan fishermen are active members of the fishing fleet and 51,3 % (or 516) of them are based in San Cristobal. Commercial fisheries consist mostly of lobster and sea cucumber, which

Puerto Baquerizo Moreno - San Cristobal Island : marina and harbor



Around 145,000 tourists visited the archipelago in 2007

According to the 2006 census, San Cristobal has a total population of approximately 6,000, of which 5,106 live in Puerto Baquerizo Moreno and 866 in rural areas

make up for half of the fishing year, while white fisheries, including tuna, groupers and wahoos, make up for the other half.

Lately, the Island's fishermen are no longer the only ones to earn their living from the sea; ecotourism has become a major source of revenue for people of the Island. In fact, tourism has become a key sector for the Galapagos's economy at large. In San Cristobal, ship captains, craftsmen, hotel keepers, sailors and cooks, all benefit from the increase in tourism activities, which has forced Cristobaleños to maintain a quality of service and seek permanent advice to fulfill visitors' expectations and comply with the increasing demand.

According to the 'Informe Galapagos 2006-2007', edited by the Galapagos National Park, the Charles Darwin Foundation, and the Instituto Nacional Galapagos, the tourism sector's annual growth rate has been estimated to an average of 14% over the past 25 years. The publication also estimates that, if such growth rate is sustained, over 500,000 visitors will annually visit the Islands within the next 10 years.

Local entrepreneurs, who have significantly invested in the Island's tourism sector, expect San Cristobal, or Chatham, to become the main tourist destination of the Galapagos Archipelago.

CO2 Emissions Reduction through Sustainable Energy Development

The primary sources of greenhouse gases emissions include water vapor, carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), and ozone (O3).

The primary greenhouse gas (GHG) emitted by human activities is CO2. Emissions from fossil fuel combustion make the vast majority of energy-related emissions, with CO2 being the primary gas emitted, including emissions from diesel power generators similar to those currently used in the Galapagos Islands.

Small islands, whether located in the tropics or in higher latitudes, have characteristics which make them particularly vulnerable to the effects of climate change, including sea level rise and extreme climatic events[1].

Deterioration of coastal conditions, for example, through erosion of beaches and coral bleaching, is expected to affect local resources, reduce the value of these destinations for tourism and jeopardize theses vulnerable small islands' environment and socioeconomic development at large.

Sea-level rise is expected to exacerbate inundation, storm surge, erosion and other coastal hazards, thus threatening vital infrastructure, settlements and facilities that support the livelihood of island communities.

Climate change is projected to contribute to the reduction of water resources in many small islands by 2050, leading to a significant risk of water shortage during low rainfall periods in most of the Caribbean and Pacific Islands which will not be able to supply their local demand for water.

Elecgalápagos S.A. existing diesel power plant

Climate change mitigation through technology transfer

The San Cristobal Galapagos Wind Power Project assists in promoting a more sustainable energy future for the Galapagos Islands and helps address the problem of global climate change attributable to emissions of GHG from fossil fuel-related energy production. The Project has developed and demonstrated sustainable and commercial approaches to deliver community-based renewable energy services. It encourages the wider use of renewable energy technologies and assists in the creation and strengthening of market mechanisms that provide incentives for the private sector to invest in these technologies. It addresses the issue of protection of biodiversity through a substantial decrease in the volume of diesel annually shipped to the islands, thereby reducing the environmental threat associated with fuel tanker oil spills, which can cause great damage to the rich biodiversity of the islands.

1.Climate Change 2007: Impacts, Adaptation and Vulnerability, Working Group II Contribution to the Intergovernmental Panel on Climate Change, Fourth Assessment Report, April 2007.

Energy policy and the environment in the Galapagos

Fuel spills are relatively frequent in the Galapagos and will probably increase if strong measures to curb the amount of fuel transported to the archipelago are not taken soon.

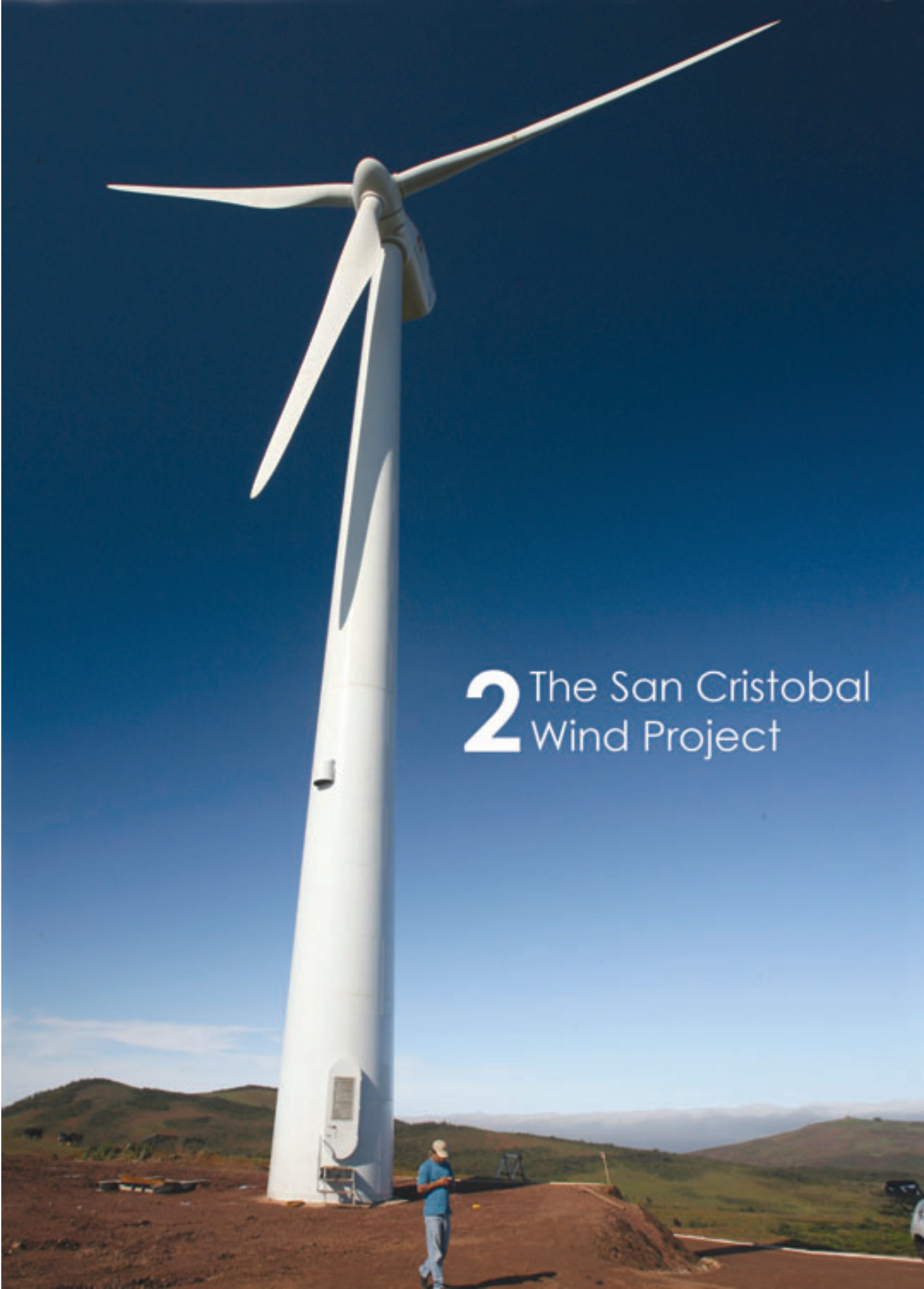
On 16 January 2001, the tanker Jessica ran aground at Bahia Naufragio in the coast of San Cristobal, spilling 75,000 gallons of fuel oil and 70,000 gallons of diesel. Meteorological conditions and the relatively quick action undertaken to control the spills lessened the damage, but evidence of severe effects on the marine iguana population on Santa Fe island were reported one year later.

The costs of proposed compensatory restoration measures were estimated at over $9 million USD (Source: Valuation of Environmental damages from the Jessica Oil Spill, Galapagos Islands, Jacobs Gibb, final draft May 2002). Other islands have suffered the impact of smaller spills, and the local population has been affected mainly due to the decrease in tourism activities resulting from the adverse publicity caused by the oil spills.

The electricity tariff in the Galapagos is highly subsidized, as is the case in much of mainland Ecuador. For example, the diesel subsidy at the national level in 2004 was $260 million USD. With the current government objective to promote the use of renewable energy for electricity generation, CONELEC, Ecuador's electricity regulating agency, established tariffs to be paid to independent power producers using these technologies as follows (recently revised under Regulation 009/06): PV —- 52.04 c/kWh; Wind —- 9.39 c/kWh; Biomass —- 9.67 c/kWh. These tariffs are valid for continental Ecuador only.

For renewable energy-based electricity generation in the Galapagos, the tariffs are 30 % higher for wind and 10 % higher for other technologies.

Elecgalápagos S.A. fuel storage tanks



2 The San Cristobal Wind Project

September 2006-October 2007, the year wind power revolutionizes electrification in the birthplace of evolutionary theory

1. Cornerstone Setting

September 1, 2006, a new era starts for Ecuadorian electrification. Luis Vintimilla (eB Project Manager) and Roberto Montesinos (former President of Elecgalapagos' Board of Directors) set the San Cristobal Wind Project's first stone on "El Tropezón".

2. Unloading Barge

Almost all construction materials, five cranes and wind turbines were shipped to San Cristobal in a 5,000-ton barge. Special cranes were used to unload each 10-ton tower section.

3. Transportation

Many special arrangements were required to move heavy big turbine parts through the streets of San Cristobal from the harbour to the hill top. Here, a fence was temporarily removed for this 33-meter long tower section to be turned at the street corner.

4. Pouring Foundations

Soil was compacted for the 3 tower foundations and concrete piles were required for one of them. 1,500 sacks of cement, 50-kg each, were used for each tower foundation.

5. Stacking Tower Segments

During the construction, very low clouds and high winds made ten-ton tower segment lifts very difficult. Two cranes were required for each tower.

6. Lifting Blades

Three long blades, three-ton and 29.5-meter each, were assembled and lifted 51 meters to be placed at the top of each tower.

7. Coupling Hub

The heavy hub and blade assembly was carried out at the top of the towers with two cranes.

8. Turbines Operating

October 1, 2007 Ecuador's first wind park is equipped with three 800-kW generators which produce an average of 50% of the electricity needed on San Cristobal Island, Galapagos.

Concept

Inception of the project

The San Cristobal Wind Project seeks to install a wind-diesel hybrid system on San Cristobal Island, Galapagos- Ecuador, to reduce the amount of diesel fuel currently used in power generation and to promote the introduction of renewable energy in the Galapagos Islands in coordination with the Ecuador´s Governement Umbrella Program in place, supported by the United Nations.

Diesel fuel has been used in the Galapagos archipelago to power generators that produce the electricity needed by its residents. Addressing the increased concern over the risk of fuel spills which continuously threaten the archipelago's unique and fragile environment, the government of Ecuador decided to explore the development of environmentally friendly power generation with the support of the United Nations through the (UNDP) United Nations Development Program.

Concerns over fuel tanker oil spills materialized when diesel tanker "Jessica" ran aground at the harbor of San Cristobal in January 2001, releasing significant amounts of oil in the Islands' surrounding waters and coast.

Objective and Goals

The San Cristobal Wind Project's main objective is to replace, as technically and economically as feasible, the existing generation system in San Cristobal Island, currently based on diesel combustion, by a clean energy source based on wind power. By displacing fossil-fuel power with wind energy the project will contribute to the Island's clean energy development, reduce greenhouse gas emissions while avoiding the increasing and real environmental risks associated with the current power generating system.

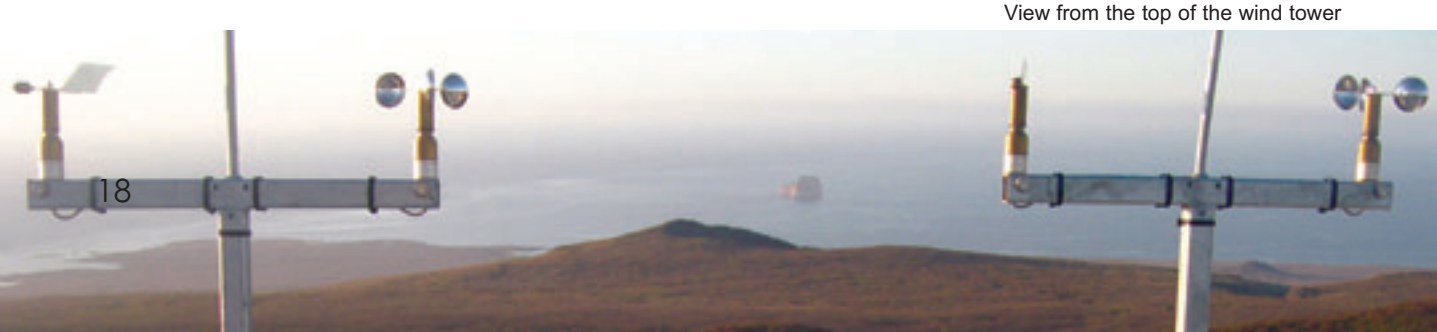
The San Cristobal Project will:

- Reduce the risks of oil spills associated with transportation and delivery of fuel.
- Reduce the atmospheric emissions of fossil-fuel emissions and greenhouse gases on a local and global scale.
- Be an example of multilateral collaboration for Climate Change mitigation under the aegis of the United Nations Framework Convention on Climate Change (UNFCCC).
- Contribute to the protection of bio-diversity.
- Decrease the Galapagos' dependence on the supply of diesel fuel and reduce the expenses associated with its delivery for the generation of electricity in the archipelago.
- Provide valuable experience for the global promotion of small-scale, renewable energy power generation and distribution systems.
- Increase the access of the local population to non-conventional, clean, energy.
- Develop public awareness of effective demand-side management and energy conservation practices.

Other Project objectives envisioned by the e8 project team include:

- Providing Elecgalapagos, the local electricity power company, environmental and financial knowledge necessary to operate a fleet of wind turbines on a sustained basis.
- Catalyzing the environmental improvements needed at the existing diesel generation plant.
- Demonstrating that, if properly developed, operated, and managed, a wind project can coexist with endangered indigenous species, such as the Galapagos Petrel.

View from the top of the wind tower



- Providing a road map for the development of wind-diesel hybrid projects on other islands.

Signing Ceremony (Paul Loeffelman, Luis Vintimilla, Jim Tolan)

Project participants

Based on the Memorandum of Understanding (MOU) signed between the e8 and the Ecuadorian government (April 25th, 2003), a project team was established to undergo the studies and implement the project. The e8 member companies provided management and technical expertise, funded the cost of in-country experts and consultants on a pro-bono basis; several other local and international partners contributed to the successful development of the project.

American Electric Power (AEP), one of the e8's nine member companies, acting as a lead company for the project's development and implementation, assigned a project leader, a project manager and a local manager in Ecuador to support the project's implementation.

The development and implementation of the San Cristobal Wind Project involved the participation of several e8 member companies. Hydro-Québec (HQ) coordinated the Environmental Impact Assessment and related bird monitoring activities in collaboration with Scottish Power (SP). HQ also provided technical expertise for the evaluation of the existing diesel generating plant on San Cristobal and identified the environmental concerns which needed to be addressed. Electricité de France (EDF), RWE, and ENEL also contributed technical expertise, and Ontario Power Generation (OPG) financially supported the project by funding a 50 meter wind measuring system.

The Galapagos National Park Service (SPNG) and the Charles Darwin Foundation (CDF) played a vital role in conducting the nesting, night-flight monitoring, mortality studies, and population enhancement activities associated with the endangered Galapagos Petrel protection program. These organizations were supported by a Bird Review Committee that provided guidance and technical peer review.

The participation and support of Elecgalapagos S.A., the local electricity utility, through their direct administrative, technical, and institutional support to the project team, was critical for the project's development and implementation.

Elecgalapagos S.A. became the e8's partner in the Commercial Trust established for the execution of the project.

With the establishment of the Commercial Trust in Ecuador, the San Cristobal Wind Project's management was passed from the e8 to the designated Trustee, Fondos Pichincha, in Ecuador. The Commercial Trust is governed by a Commercial Trust Committee composed of three members: AEP, RWE (e8 member companies) and Elecgalapagos S.A. After the first few years of operation, the majority of seats on the Trust Committee will be passed on to Elecgalapagos S.A.

Ecuadorian President Mr. Rafael Correa being updated by Mr. Luis Vintimilla, project manager and Mr. Paul Loeffelman, project director

The UNDP regional office in Quito, Ecuador, was an important project team participant, mainly through its role in managing the e8's and the United Nations Foundation's (UNF) grants towards the project. UNDP staff supported the project team in addressing key local administrative matters, including imports duty exemption and sales tax (IVA) reimbursement processes.

Elecgalápagos S.A. diesel power plant

Beneficiaries

The primary beneficiaries of the San Cristobal Wind Project are Elecgalapagos S.A., the residents and environment of the Galapagos (local communities, flora and fauna) and the people of Ecuador at large. The San Cristobal Wind Project is a key element of Ecuador's objective to eliminate the use of fossil fuels in the Galapagos by the year 2015.

Elecgalapagos S.A will eventually assume ownership of the wind project and its staff will have received valuable training and expertise in constructing and maintaining renewable energy systems.

Indirect beneficiaries of the project are countries with remote populations or island communities seeking the development of renewable energy sources and the achievement of sustainable development. At many levels, the project provides benefits to other countries by:

- Providing a development model for other renewable energy projects.
- Serving as a cost reference for high penetration, wind-diesel hybrid systems in remote locations.
- Presenting a model of private-public partnership, which can serve as a blue print for future similar projects.

Eólica San Cristóbal S.A.
EOLICSA

ELECGALAPAGOS S.A.

Managing the San Cristobal Wind Project

Administration

The e8 proposed that the San Cristobal Wind Project be implemented through a legal entity that would be registered in Ecuador as a Commercial Trust Fund. This legal entity would in turn establish a Corporation (Sociedad Anónima as per Ecuadorian Law) as an Independent Power Producer (IPP), which would generate renewable energy and sell it at the wholesale price level to Elecgalapagos (Local distribution Company), thus complying with Ecuadorian regulations. The Trust provisions allow that Elecgalapagos and/ or others, may assign funds or assets or rights to the Trust, with prior compliance with the Ecuadorian legal requirements, and thus join the Trust as "Adherent Settlors" and/or be designated as Trust beneficiaries.

The work plan for the San Cristobal Wind Project is to treat the entire Endeavour as a business, with a business plan, proper management and governance, and training of the workforce. Since the projects' capital funding does not require repayment, all income generated from the project can be reinvested in the project to help support further renewable energy development in San Cristobal.

The Trust and Elecgalápagos S.A are the shareholders of the corporation, Eólica San Cristóbal S.A. (EOLICSA). The corporation EOLICSA received the Generating Permit from CONELEC to construct and operate the wind park and sell energy at the wholesale price level to Elecgalapagos and/or others, as prescribed by CONELEC regulations.

After the 12-year operating period established by CONELEC regulations, or if regulations are modified in the future, it is possible that the corporation may seek a supplemental Power Purchase Agreement (PPA) to clarify terms and conditions of the sale of wind energy to Elecgalapagos.

Also, Elecgalapagos, which serves as the distribution company, will retain sole ownership and complete responsibility for the existing diesel generating plant.

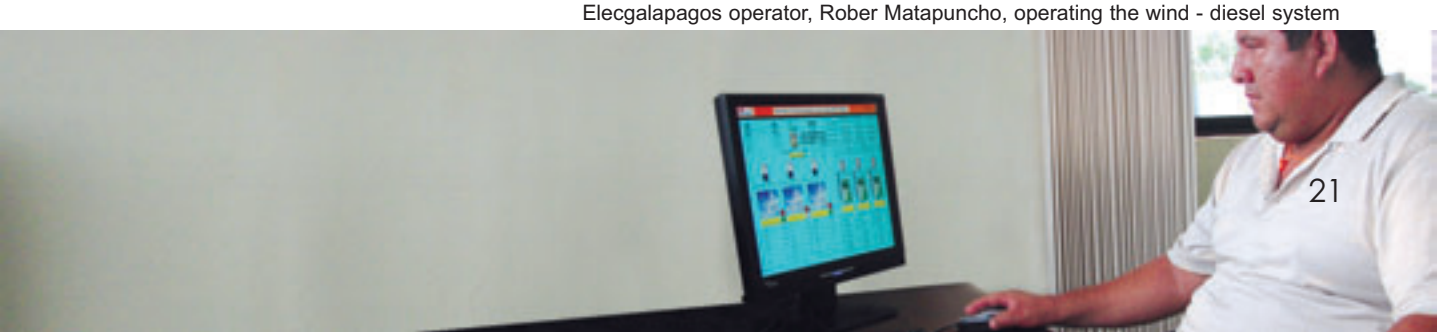
The corporation, "Sociedad Anónima", entered into an Operations and Maintenance Agreement (O&M) with Elecgalapagos to provide the Operation, Maintenance and Dispatching services of the San Cristobal Wind Project on a contract basis.

The members of the e8 are not owners of any shares of the corporation. Instead of focusing on ownership, the e8 members will focus on the project's governance and oversight during the earlier years of operation of the wind park. In this regard, members of the e8 will hold the majority of seats in the Trust Committee during the first six years of operation. This period entails the construction period, warranty period, initial operation, petrel mortality monitoring, completion and renegotiation of long-term maintenance and service contracts, and possible first replacement of the battery system (if used). This outright majority may be warranted considering the e8's role as project developer, and the need for the e8 to conduct significant human capacity building and to provide continued technical expertise and training.

Stakeholders' Financial Contribution

The financial structure of the San Cristobal Wind Project is unique. The funds, which are managed by the Trustee of the Commercial Trust, consist of a combination of international grants (United Nations Foundation and e8), Ecuadorian Government grants (FERUM) to promote renewable energy projects, and Ecuadorian taxpayers' designated income tax payments. The municipal government of San Cristobal declared the Wind Project as a legally-defined "community beneficial project"

Elecgalapagos operator, Rober Matapuncho, operating the wind - diesel system



thus allowing Ecuadorian taxpayers to annually designate up to 25% of their national income tax payment to the municipal government for the project (See Table1).

The Trust Agreement specifies the contributions and roles of each stakeholder (settler).

The San Cristobal Wind Project's funding

e8 Capital Fund Contribution	$ 5,475,640
UNF Matching Grant to San Cristobal Project	$ 326,196
Income Tax Payments	$ 408,643
Ferum Subsidy	$ 3,305,519
Total Funds	$ 9,515,998

Partnerships

Elecgalapagos, the vertically integrated utility in the Galapagos, has become the e8's partner in promoting and developing the Project.

Elecgalapagos currently holds the authorization from CONELEC to increase its generation capacity by means of renewable energy systems. Current legislation allows Elecgalapagos to choose between developing renewable energy systems themselves or entering into agreements with partners for the project development and operation with CONELEC's approval.

Prior to structuring the formal Commercial Trust of the Project, and the potential adherence by Elecgalapagos, an "Agreement for Preliminary Activities" was signed on July 1st, 2003. Based on this Agreement, the e8 carried out several institutional, financial, engineering, environmental and other related activities, with the cooperation and local support of Elecgalapagos.

The participation of the e8 in this project is facilitated through a 1994 Memorandum of Understanding (MOU) between UNDP and the e8 for collaboration on issues of climate change and sustainable development in UNDP countries.

Elecgalpagos staff

It is within the context of this MOU that UNDP solicited the support of the e8 in the re-powering initiative in the Galapagos, upon completion of the pre-feasibility study performed by the International consulting company, Lahmeyer. The rationale behind the e8's support is the extensive experience of its members in electricity generation, transmission, distribution and operation activities world-wide, its expertise in implementing PV/Wind/Diesel hybrid systems both in its member countries and in the developing world, and its desire to support UNDP countries in their effort to promote sustainable development and reduce poverty through the provision of clean, efficient and reliable electricity services to the rural poor worldwide.

A Memorandum of Understanding (Convenio) was signed by the Ministry of Energy and Mines, the Ministry of Environment and UNDP on 20 February 2002. This MOU states that "the Government [of Ecuador] has expressed its interest in re-powering the Galapagos with renewable energy in view of the risks associated with transportation and transfer of fuel oil for operating the present system of thermal generation (diesel) and the emission of GHG at the local and global levels".

Other civil society partners involved in this project are the Charles Darwin Research

EEPG : President, Mr. L. Zaragocín; General Manager, Mr. P. Andrade and Lawyer Ms. L. Tipán

Signature meeting whereby Elecgalapagos adhered to the Trust

Meeting with GNP and CDF representatives

Foundation and the former Ecuadorian Ornithological Corporation – CECIA (currently Aves y Conservación). These institutions, together with Elecgalapagos, the Galapagos National Park Service and an expert ornithologist, provided guidance and support in structuring the project so as to avoid any potential negative impact on the Galapagos' Petrel endangered bird species. These institutions played a vital role in supporting the e8 Project Team in the elaboration of the project's environmental impact assessment. They have been part of a Petrel Protection Committee, composed of ornithologists from the CDRS, the Catholic University of Quito and the Ecuadorian Ornithological Corporation – CECIA, put in place to develop a comprehensive Environmental Management Plan for the Wind Project.

Environmental procedures

To determine the Project's feasibility, a preliminary Environmental Impact Study and a Definitive Environmental Impact Assessment were prepared.

The Environmental Impact study (EIS) was completed and submitted after public consultation in September 2004.

The Ecuadorian government approved it with minor comments and no opposition from stakeholders. The EIS includes a 15-year Environmental Management Plan for the project with long-term monitoring of the endangered Petrel and provisions for mitigation and enhancement of the bird's population.

The e8 team, the Galapagos National Park Service staff, and expert ornithologists, gathered in a committee convened by the e8, met in May 2005 to determine detailed activities and timelines to implement the plan.

Public hearing for the environmental impact assessment, San Cristobal

Protecting an indigenous endangered bird species

The protection of the endangered Galapagos Petrel constitutes the major environmental concern associated with the Wind Project. The Galapagos Petrel is one of the six endemic marine birds of the Galapagos Archipelago and has been declared as "critically endangered", by the World Conservation Union (IUCN).

The Petrel nests in underground borrows and its eggs and chicks are preyed upon by rats and cats. Nesting areas are located in the highlands of several islands, in sites with dense vegetation and soil. In past decades, the species was seriously impacted by the expansion of land used for agricultural purposes and the associated increased presence of predators and other invasive species that crowd out plants supporting the Petrel.

The Environmental Management Plan identified a series of mitigation and enhancement measures which have been instituted during the project's implementation. Many of these measures focus on the Petrel. It is intended that these measures will not only act to minimize impact of the project on the

Petrels couple in nest: San Cristobal highlands

Petrel bird expert and e8 consultant for the Petrel Protection Programme

Petrel, but would actually help increase the Petrel population by controlling adverse invasive species and predators, conserving and protecting habitats and ensuring long-term scientific monitoring of the bird's well being.

Other environmental considerations

The existing diesel plant ownership, operation, and control will be retained by Elecgalapagos, the operating conditions and environmental practices of which need some improvements. Elecgalapagos has undertaken an environmental audit of the power stations in San Cristobal, Santa Cruz and Isabela, and CONELEC has issued concrete recommendations for improving the storage and handling of fuel in Elecgalapagos facilities in each island. These recommendations, together with those suggested by the e8, include better management of petroleum products, better spill prevention and containment, proper handling of waste and storm-water streams, enhanced noise control, relocation of diesel exhausts, and disposal of accumulated industrial waste.

Project Engineering, Development and Implementation

Project engineering

Technology

Hub ready to be lifted at wind turbine No. 2

The system implemented by the San Cristobal Win Project is considered a "high penetration" wind-diesel hybrid system, as the wind turbines are expected to produce more that 50% of the power electrical demand. Hybrid systems require careful engineering and analysis to ensure that customers' electricity demand is satisfied through an optimal balance between the energy supplied to the grid by the wind turbines and diesel generators.

Reaching this balance represents the main challenge associated with wind-based hybrid systems, given the intermittent nature of wind power, and the variance in consumers' electricity demand. An additional challenge resulting from the intermittent nature of renewable energy technology is the high cost and difficulty of storage of this type of energy.

These problems are addressed by the wind resource, electrical demand assessment, equipment selection, and fast-acting electronic controllers.

Another significant element to address when implementing wind energy systems is the identification of the most adequate system location. To ensure the viability of a wind energy project, a comprehensive wind monitoring program is needed to measure the wind over a prolonged period of time, allowing to determine the optimal site to locate the wind system. For the San Cristobal Wind Project, two 20-meter tall wind-measuring towers were in operation for more than 5 years before construction started. Data from the wind measuring towers and topographic maps of the project area were analyzed by computer models to determine the potential power output of the wind turbines over the course of one year. This modeling identified potential locations for the wind turbines. When the final project location on the hill named "el Tropezon"

Turbine blades arrive at site

was determined, a 50-meter tall wind tower was located on that hill to verify the results of the computer modeling and confirmed that El Tropezon had adequate wind energy for the project to proceed.

Project Definition

The San Cristobal Wind Project definition followed the "design spiral" process. The "design spiral" approach starts with defining the general project requirements, performing studies, and then proposing the conceptual design.

The Wind Project, as envisioned in the Pre-Feasibility Study prepared in December 2001, was based on approximately 1,750 kW of installed wind capacity and small photovoltaic capacity coupled with the existing diesel generator plant in San Cristobal.

The e8 accepted the results of the Pre-Feasibility study, and agreed to study the project in more details during the Feasibility Study Phase.

The Feasibility Study phase was broken into specific tasks which were assigned to e8 member companies or Ecuadorian professionals. In addition to American Electric Power (AEP), acting as the team leader, lead and support organizations were designated to implement the identified project tasks. A project website was established to facilitate the exchange and sharing of project files among all actors involved in the study.

The e8 Feasibility Study Phase included an Environmental Impact Study, geotechnical investigations, site surveys and topographic modeling, archaeological investigations, a monitoring program for the protection of the Galapagos Petrel, engineering studies, and continued monitoring and modeling of the wind resource of the island's electrical demand.

Based on these comprehensive results, a feasibility study report was prepared by the e8 and approved in February 2005. The feasibility study report identified a baseline system of 3 x 660 kW wind turbines with a total output of 1,980 kW, with a battery energy storage system, coupled with the existing diesel generator plant.

System Selected

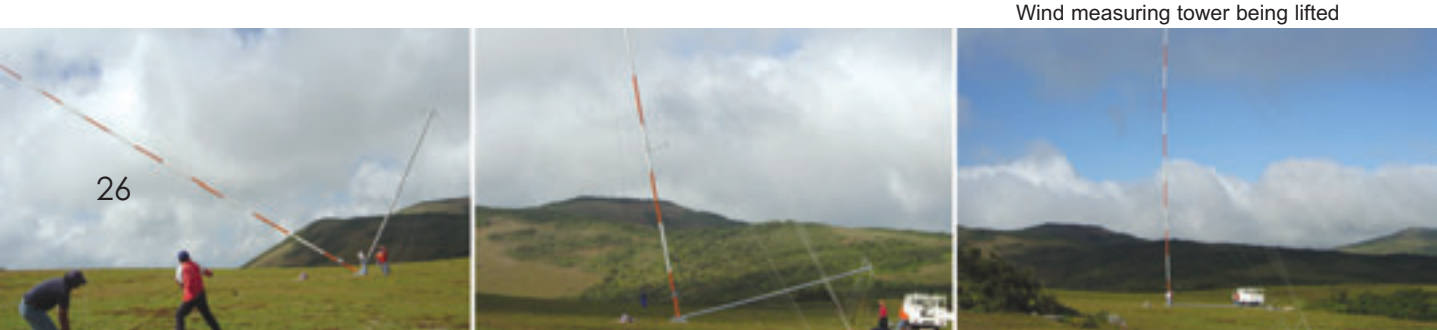
A competitive bidding process was held for the supply and construction of the Wind Project. The final configuration of wind turbines (manufacturer, kW rating, quantity, blade diameter and rpm) was selected based on the market offerings at the time of the construction tender.

SANTOS CMI staff with Project Manager, Luis Vintimilla and Field Supervisor, Simon Caicedo

MADE of Spain was selected as the supplier of the wind turbines, controls, and automation of existing diesel generators. Santos-CMI of Ecuador was selected as the Wind Project constructor and logistics coordinator.

The system selected includes three (3) 800 kW variable speed, synchronous wind turbines with no energy storage provisions. Three (3) 650 kW of the existing diesel generators benefit from automated controls. A Control System would dispatch the wind turbines and diesel

Wind measuring tower being lifted



generators in hybrid mode, ensuring power supply and quality to meet power electrical demand.

Wind turbine generator manufactured by Made in Spain

The Wind Turbines are MADE Model AE59 with 59-meter diameter blades and 51.5 meter hub height, with a capacity of 800 kW each. The wind turbine blades were optimized for the wind characteristics of the Galapagos Islands.

An electrical "collector" system gathers the power from each wind turbine through underground cabling and transport the power down the hillside to the wind park boundaries where it interfaces with a transmission line. Leaving the wind park, the first 3 km of the line run underground to minimize the possibility of collision, between the endangered Galapagos Petrel and the line. The transmission line then converts into an aerial conductor for approximately 9 km where it ties into the current distribution system at the diesel Plant.

A new Control Building was built adjacent to the existing Elecgalapagos S.A. Diesel plant control room area. The Control Building includes a control room, archives room, and an office for the Wind Project Operations Management team.

Provisions in the contract signed with MADE include the possibility of remote monitoring and troubleshooting of the wind turbine equipment via Internet by MADE staff in Spain.

The San Cristobal Wind Project does not include energy storage provisions due to maintenance and environmental considerations.

While the system implemented will frequently generate more energy at night than the island's electrical power companies require, this excess energy cannot be captured and used with the current system.

Project team: cooperation was key for success

Energy storage may be considered for the project, in later years, as battery technology or other technologies are improved and become more cost effective.

More technical details about the San Cristobal Wind System and its hybrid operation and control systems may be found on the project's website, at:

www.eolicsa.com.ec

Transmission line was buried in the highlands to avoid impact on Petrel and other birds' flight patterns

Project Development and Implementation

Project Development

The development of the San Cristobal Wind Project was undertaken by the e8 based on the following principles:

- The Project was implemented and operated by the e8 jointly with Elecgalapagos S.A. as the Ecuadorian in country partner.
- An ownership and management structure was defined, which would accommodate the needs of the public and private partnership envisaged for the project's development and financing.
- Transparency and a streamlined organization were critical to allow the project to quickly address issues that would arise in the final stages of development and during implementation.
- Risk management measures were to be incorporated to allow the project to continue progressing while withholding final approvals until unresolved issues were addressed.

To apply the principles outlined above, a two-fold solution was undertaken:

The establishment of a Commercial Trust, and a project implementation based on Limited-Notice-to-Proceed (LNTP) and Full-Notice-to-Proceed (FNTP).

The e8 Companies and Elecgalapagos S.A established the Fideicomiso Mercantil Proyecto Eolico San Cristobal, the San Cristobal Wind Project Commercial Trust, to oversee the construction and operation of the San Cristobal Wind Project. The Commercial Trust was established under Ecuadorian law.

The Commercial Trust exists on a "not-for-profit" basis. Any proceeds generated by the project will be used for the long-term sustainability of the San Cristobal Wind Project or will be rechanneled to support other renewable energy or energy efficiency programs in the Galapagos.

e8 member companies, namely AEP and RWE, acted as "settlors" of the Trust, and were each granted a seat on the Trust Committee. Elecgalapagos S.A. was an "Adherent Settlor" to the Trust and is the sole beneficiary.

e8 member companies provided the largest share of the project's funding, on a pro-bono basis, and continue to offer management and technical expertise for the project.

An authorized trust company in Ecuador, Fondos Pichincha, was assigned as Trustee, holding fiduciary and legal responsibility. After a formal bidding process, the Commercial Trust awarded the equipment and construction contracts.

As an adherent settlor to the Commercial Trust, Elecgalapagos agreed to perform the following functions:

- To become the eventual sole beneficiary of the Commercial Trust.
- To participate in the Commercial Trust and support the acquisition of the generating permit for the project.
- To provide authority for the Wind Project to obtain legal title to Land Easement for the Wind Project site at El Tropezon and the transmission line easements.
- To continue to own, operate, and maintain the Diesel Generating Station.
- To provide free lease for the Wind Power project equipment and control room at the diesel generating station in place.

Trust committee meeting with Fondos Pichincha as trustee

- To serve as the vehicle used for the Ecuadorian government's capital funds to be applied to the Wind Project.

- To sign the required Power Purchase Agreement for the terms of the Wind Project power sales to Elecgalapagos as a distribution company.

- To sign the Operation & Maintenance (O&M) Agreement required to operate and maintain the Wind Project on behalf of EOLICSA, the corporation established to operate the project according to Ecuadorian law.

With the legal structure of the Wind Project defined, a Project Document was signed between the United Nations Development Program, the government of Ecuador, and San Cristobal Wind Project Commercial Trust in September 2005.

The establishment of the Commercial Trust and signing of the Project Document triggered the transfer of funds from the Ecuadorian Government, the e8 and UNF matching grant to the Wind Project.

With the structure and funding in place, the Commercial Trust granted Limited-Notice-to-Proceed (LNTP) to the wind turbine equipment supplier and constructor. The LNTP phase was intended as a risk-mitigation measure to allow progress and finalize preliminary engineering issues that could impact project costs or configuration. Also, pending institutional issues were resolved during this period. During the LNTP phase, only limited project funding was authorized.

The conditions for moving from the LNTP to the Full-Notice-to-Proceed (FNTP) phase were clearly defined in the Commercial Trust Constitution under the "Point of Initiation" clause.

These conditions included the Ecuadorian government's final approval of Elecgalapagos legally joining the Trust, the receipt of final environmental and generating permits, the approval of a Power Purchase mechanism with workable provisions for the Wind Project to receive the defined tariff revenue, the receipt of the needed land easements, and the acquisition of all the funds needed to implement the project.

The conditions specified in the FNTP were met in May 2006 and the Commercial Trust granted the Wind Turbine Supplier and Constructor direction to proceed with equipment manufacturing and construction in June 2006. The LNTP and FNTP approach was deemed successful as it imposed restraint on the project team not to proceed at risk until critical issues were resolved.

Project Management and Technical Team

The Constitution of the Commercial Trust required that a project director be designated for the project. The project director is responsible for the administration and supervision of the project's engineering and construction, operation and maintenance activities. This includes the elaboration of reports, budgeting, coordination between all parties, development of contracts and liaison with the e8.

The success of the Wind Project was significantly due to the establishment of a highly talented and experienced project team during the implementation phase, with individuals and companies with a fervent and beyond-normal commitment to the success of the project.

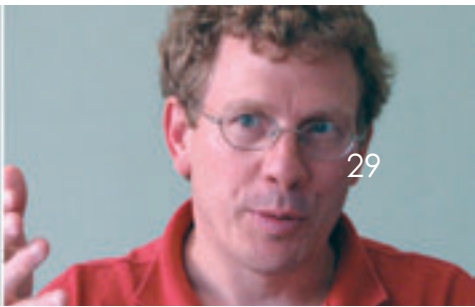
Team members during implementation phase included:

- Team Leader and Trust Committee Member Mr. Paul Loeffelman, AEP(USA).

Mr. Paul Loeffelman

Mr. Klaus Baumann

Mr. Jim Tolan



- Trust Committee Member – Mr. Klaus Baumann, RWE (Germany).

- Project Director - Project Director Services – Industry & Energy Associates. (USA), Mr. Jim Tolan and Mr. Luis C. Vintimilla C. (Ecuador).

- EOLICSA General Manager – Mr. Luis C. Vintimilla C. (Ecuador).

- Board, Management and Staff of Elecgalapagos S.A.(Ecuador).

- Trustee Fondos Pichincha (Ecuador) Legal Advisor - Bustamante& Bustamante (Ecuador).

- EOLICSA Operations Manager, Mr. Jose Moscoso (Ecuador).

- Engineering advisors and supervisors during field construction activities: Mr. Simon Caicedo, Mr. Oswaldo Yepez and Mr. Daniel Torres (Ecuador).

Support on studies related to several aspects of the project was provided by:

- Technology Insights (USA).
- Walsh Environmental (Ecuador).
- Cartotecnia (Ecuador).
- Inelin (Ecuador).

Contractors for execution of facilities were:

- MADE, Tecnologías Renovables, S.A. (Spain): equipment.

- Consorcio Santos-CMI (Ecuador): construction.

- ELECDOR (Ecuador): transmission line.

The project team benefited from the support of many government institutions and local agencies, including the Municipality of San Cristobal, the Provincial Prefect of the Galapagos, INGALA, the Ministry of Energy and Mines, the Ministry of Environment, CONELEC, Fondo de Solidaridad, Galapagos National Park, Charles Darwin Foundation and the Ecuadorian Navy.

Day-to-day management of the Wind Project was performed by the Project Director and Local Manager. All contracts for equipment supply, construction or consultants were drafted by the project director and executed by the Trustee.

The Project Director and Trustee were responsible for the preparation of quarterly financial reports submitted to the Commercial Trust Committee and UNDP. In addition, the project director also provided quarterly narrative progress reports and other reports as required by the Project Document signed with the Government of Ecuador and UNDP.

The Trust Committee held two regular meetings annually; one in Quito and one on San Cristobal.

Wind turbine blades being lifted by special cranes

Construction

MADE and Santos- CMI were given direction to proceed with equipment manufacturing and construction in June 2006. The project team had originally proposed project implementation

Barge at La Predial pier

Off loading wind tower

Moving through San Cristobal streets

under a "turn-key" Engineering, Procurement, and Construction (EPC) contract, but later decided to proceed with separate equipment supply and engineering-construction contracts. This decision required the project team to take on additional project coordination and management duties, but yielded overall cost savings.

Based on the Wind Turbine manufacturing schedule, a two-phase approach for the project's construction phase was planned.

Phase I activities included road construction, underground cable installation, site preparation, mining of aggregates and sand of suitable quality for wind turbine foundation concrete. During the Phase I period, an existing pier in the harbor was fortified and extended slightly to accommodate the ocean barge Santos-CMI used for the transportation of the large construction and wind turbine equipment.

Blessing of the first stone : Groundbreaking Ceremony, San Cristobal, September 1, 2006

A ground-breaking ceremony was held at the project site on September 1, 2006. Phase I activities began at that time and were completed in December 2006. The Santos-CMI workers building the access road were subjected to the "garúa" phenomenon of the Galapagos highlands – wet, windy, and fog-like harsh weather conditions.

Phase 2 activities involved building the wind turbines' foundation, erecting the wind turbines, completing the collector system between wind turbines and grounding circuits, completing the substation, building the Control House, installing the automated controls on the existing diesel generators, and commissioning the systems.

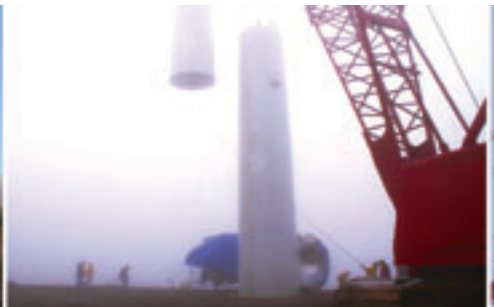
Preparation work for the foundations began in February 2007, and the first large barge shipment of construction equipment, the wind towers, and foundation anchor rings arrived on site in March 2007.

Constructing the wind turbine's foundations was a logistical challenge. Two batch cement plants were brought to the island as well as cement mixer trucks. Approximately 4,500 large sacks (225 Tons) of cement were imported from the continent. Using aggregates and sand mined from the island, test batches of concrete were made and subjected to laboratory tests for the analysis of strength characteristics; these tests yielded successful results. Soil characteristics in the foundation area required each foundation to be deeply excavated, and the removal of poor soil with an "engineered" fill of proper quality for compaction. On Wind Turbine #3, the depth of excavation required to reach adequate quality soil was deemed excessive giving the site topography. As a result, the foundation design for that unit was changed to incorporate concrete piles.

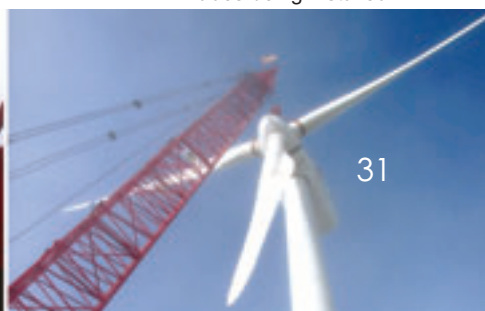
For all stages of the foundation design and construction, Santos-CMI proceeded under the guidance of geotechnical and engineering specialists, followed widely accepted industry practices, and performed compaction and materials testing. After MADE's approval of the foundation engineering and methodology, construction of the foundation installations started in April 2007 and was completed in June 2007.

Tower anchoring rings

Wind tower assembly



Blades being installed



The large barge, carrying the wind turbine supporting towers, cement and construction equipment arrived in San Cristobal on March, 2007. A second shipment carrying wind turbine nacelles, wind turbine blades, electronic equipment, and balance of plant equipment and materials, arrived in San Cristobal in late July 2007. The barge was also used to transport the 230-ton crane needed to erect the wind turbines, heavy haul trucks, and smaller cranes needed to support unloading and construction activities.

Some of the main logistical challenges faced in the construction phase, include the absence of a functional crane in San Cristobal prior to the development of the project.

During the turbine erection period in Phase II of construction, Santos-CMI had transported five cranes to work on the Wind Project site.

The wind turbines were erected in August 2007 by Santos-CMI under the supervision of MADE's technical experts from Spain. During the same period, Santos CMI completed the substation and completed outages on the island's three main diesel generators to automate their control systems.

Manufacture of elements and installation of the overhead transmission line was carried out by ELECDOR from January through June, 2007.

Construction Monitoring

The Project team monitored construction activities at different levels.

Safety, security, environmental compliance, work quality, and contractual compliance were monitored by the project director. These monitoring activities were conducted via various means.

Weather conditions increased the challenges of safely installing the turbines while causing minimal environmental impact.

Contractual

All equipment supply and construction contracts reflected the requirements of the Environmental Management Plan (EMP) designed for the Wind Project and approved by the e8, CONELEC, and the Ministry of Environment. The EMP required detailed programs for safety, security, community relations, environmental compliance, waste, and reporting.

Santos-CMI was assigned primary responsibility for coordination of other on-site contractors with respect to safety and security.

Reporting

The primary constructor for the Wind Project, Santos-CMI, produced bi-weekly reports on environmental compliance. These were submitted to the project director and shared with the wind project's environmental consultant, Walsh.

The contractors and wind turbine supplier were required to provide monthly progress reports. A general monthly report was shared with the main stakeholders in the Wind Project (Commercial Trust, e8, Elecgalapagos, Ministry of Energy and Mines, Ministry of Environment and CONELEC).

Truck with tower section crossing through El Progreso Village: community support was very important for the project success

The project director's team also submitted quarterly, semi-annual, and annual reports as required under the Project Document signed with the Government of Ecuador and UNDP. An overall accounting of project funds and expenditures of all funding sources was provided by the Trustee, Fondos Pichincha. The project director's was responsible for elaborating a "Working Budget" with the objective to track the original budget, forecast the budget of future costs, funding received, pending funding, and investment income. The project director's "Working Budget" was a key tool to help manage the project budget and capture actual costs as reference for future projects.

Unexpected costs were incurred due to the increases in world commodity prices such as steel, copper, cement, and petroleum, and also due to unforeseen and costly administrative matters. Through careful budget management, earnings from investment on the capital funds, and income tax payments from donors in Ecuador, overall funding was secured for the project's full completion.

The Wind Project Team had to develop adequate cash flow models to effectively address the financial requirements involved by start-up operational costs, the use of project funds as collaterals, and delays in expected income payments. To that end, a line of credit was established, through the Trustee, with a major Ecuadorian bank, to release operational funds for the project, collateralized by the pending IVA reimbursements from the Government.

On-Site Observation

The wind project team maintained construction supervisors on site in San Cristobal throughout the construction and commissioning phases. During the road site preparation, road building and foundation activities, a civil engineer was present and reported to the local manager on a daily basis. When the large wind turbine foundations were being prepared and concrete poured, a structural engineer, representing the Commercial Trust, was at the El Tropezon site to witness critical construction activities and perform testing.

Working session at control room: Project Manager Luis Vintimilla with Operations Manager Jose Moscoso

When the wind turbines' erection began and commissioning activities started, an electrical construction supervisor was at the project site, representing the Commercial Trust. This person was a supplement to the EOLICSA operations manager who was also assigned to the island for the supervision of these activities and who coordinated system automation upgrades on the operating 650 kW diesel generators with Elecgalapagos.

As required by the EMP, a registered archaeologist was at the project site for the construction activities involving earth movement. The archeologist was part of the Walsh-Ecuador team. He was cross trained in environmental management and played a significant role early in Phase 1 construction activities, working with the contractor to implement the environmental monitoring compliance system.

In addition to on-site observation, it is important to recognize the Community Outreach

Program conducted along with the Wind Project. As required by the EMP, delegates from Walsh-Ecuador conducted door-to-door visits to meet the local community on San Cristobal, inform them about the pending construction activities and record their potential concerns over to the Wind Project. In general, the community and local institutions were highly supportive of the wind project. The Community Outreach program included radio announcements and the diffusion of informative posters in the community. To keep the local community informed about the progress of the project, the project's Local Manager was interviewed by the local television and national radio stations on a regular basis.

Auditing

The Wind Turbines were manufactured in strict accordance to IEC and ISO quality standards in Medina del Campo, Spain.

Santos-CMI followed its internal reporting systems for assessing project progress, quality, safety, and environmental compliance. These reports were shared with the Commercial Trust and stakeholders.

To ensure compliance with the Environmental Management Plan, the Commercial Trust contracted Walsh-Ecuador to audit the project's compliance with the EMP and to prepare the necessary reports for the Ecuadorian government. Walsh provided the on-site archeologist and visited the project at key phases of construction to monitor and audit environmental compliance.

At the higher project level, the Commercial Trust's reports were monitored by UNDP. Also, special reports and verification of project progress were submitted to CONELEC and Fondo de Solidaridad for the release of Government funds in accordance with the milestone payment schedule.

The Trustee's accounts have been audited by international accounting firms. Also, UNDP conducted its own routine audit of project funds and activities in 2Q 2007 via an independent accounting firm. No irregularities were reported in any of the audits; project activities were conducted with the highest levels of transparency and reporting to the stakeholders.

Operations

Monitoring of the hybrid system by Made engineer, Jose Jara

In accordance with Ecuadorian electric sector laws, a Corporation (Sociedad Anónima as per Ecuadorian Law) was established to operate the San Cristobal Wind Project. This corporation is referred to as Eólica San Cristobal S.A. - EOLICSA. The Commercial Trust is EOLISCA's primary shareholder along with Elecgalapagos. In time, all shares of EOLICSA will be transferred to Elecgalapagos.

To ensure continuity in the project's management, the project's local manager, Luis C. Vintimilla C., was designated as the general manager of EOLICSA, holding responsibility and oversight over the project's operations.

The project's legal advisor, Alfredo Larrea F, a member of Bustamante&Bustamante Law Firm, was designated president of EOLICSA. Both the president and the general manager report to EOLICSA's shareholders. EOLICSA assigned

Jose Moscoso A. as the project's operations manager, who resides on the Island of San Cristobal and holds responsibility over on-site operations and technical hands-on training.

In order to maintain a flat and economical organizational structure and ensure effective technical monitoring, a strategic Operation and Maintenance contract (O&M) was signed with MADE for a two-year period. Under this contract, MADE will provide, upon commissioning of the project, a full-time representative on San Cristobal to assist with operation and maintenance of the wind farm and hybrid system. Additionally, through protected Internet links to the wind project control system, MADE experts, in Spain, will be able to monitor or operate the project's equipment, if needed, and obtain data for maintenance and troubleshooting activities.

EOLICSA also intends to reach agreement with Elecgalapagos for operation, maintenance and repair support of the Wind Turbines. Instead of manually operating and dispatching the existing diesel generators, Elecgalapagos watch stander staff will now control the dispatch of the units, with computers, from the new hybrid control system located in the new control building.

The system will have the capacity to run in automatic mode, whereby the control system dispatches wind turbines and diesel power according to the level of the electrical power's demand on the one hand, and availability of wind at the El Tropezon wind park on the other.

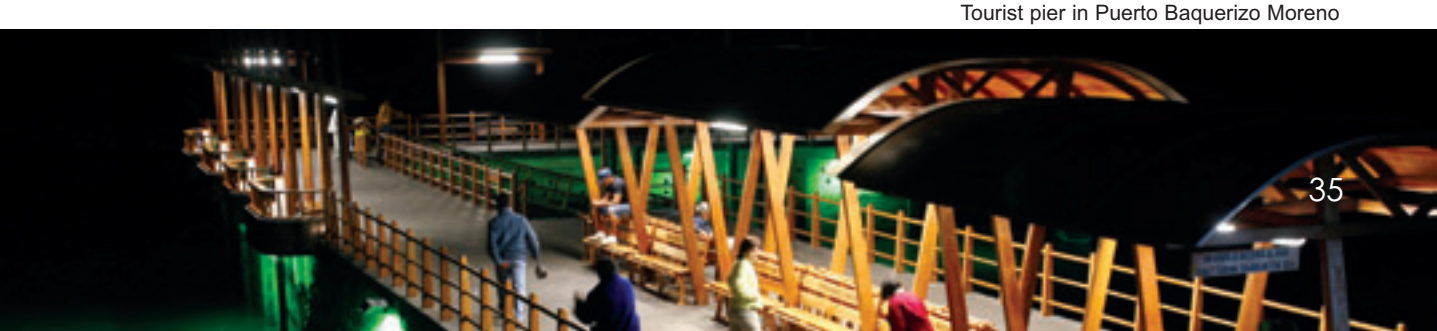
Expected results

The Wind Project is expected to significantly reduce San Cristobal's consumption of diesel fuel. Modeling of the hybrid system using the US National Renewables Energy Lab (NREL) internationally recognized HYBRID2 computer model indicates the following annual performance levels will be achieved.

Year	Power Demand (kWh)	Wind Energy Delivered(kWh)	% Diesel Displacement
2008	7,981,164	4,126,164	52 %
2013	10,186,114	4,887,240	48 %
2018	11,808,498	5,375,724	46 %
2023	13,689,286	5,932,941	46 %
2028	15,869,643	6,626,638	42 %

Puerto Baquerizo main street along the harbor, by night

Tourist pier in Puerto Baquerizo Moreno



Interview with Mr. Luis Vintimilla - Project Manager

What are the basic aims of the San Cristobal Wind Project?

The basic purpose of the project is to replace the current diesel-based electricity generation on Isla San Cristobal with wind power as a clean and renewable energy source, as much as is technically and economically feasible. This will reduce the risks of oil spills and limit greenhouse gas emissions.

What entities have been responsible for developing this project?

The project is part of the Renewable Energy Program administered by the Ministry of Energy with support from the UNDP. It was developed on Isla San Cristobal thanks to a significant donation of funding and technical expertise from the member companies of the "e8", an alliance of electric companies from the G8 Group of industrialized countries. Additional financing has also been provided by the United Nations Foundation. The local counterpart is Elecgalapagos S.A., which has contributed resources from the Marginal Rural and Urban Electrification Fund (FERUM). Donations have also been received from income taxes paid by large businesses and channeled through the San Cristobal Municipality. All of these funds are administered through a Commercial Trust Fund.

What environmental consequences will the Project have?

The site for the wind farm was selected based on rigorous and in-depth field studies in order to avoid affecting two species found in the area: the endangered "Galapagos petrel", and the endangered plant "miconia robinsoniana". The e8 carried out these studies with significant support from the Galapagos National Park, the Charles Darwin Foundation, and with ongoing supervision from a high-level Committee. The Environmental License granted by the Ecuadorian Ministry of Environment includes a detailed Environmental Management Plan with a well-defined budget to ensure its successful implementation.

Will diesel-based generation be entirely eliminated from the island?

That would be ideal, but there is not enough wind year round. In particular, during 4 months of the year with unfavorable wind conditions, during certain hours on certain days, it will be necessary to continue using diesel-generated electricity. However, it is recommended that future work be done on projects to substitute the diesel currently used with a more environmentally friendly fuel.

The San Cristobal Wind Project will annually replace approximately 50% of diesel generation with clean energy, but can reach up to 80% during the high wind season

What local participation is there in the Project?

Elecgalapagos S.A., a state-owned company belonging to Ecuador's Solidarity Fund and sectional governments, will be the absolute beneficiary of the project. The e8 will continue to work with Elecgalapagos S.A. for a certain period of time, providing the necessary support for the administration, operation and maintenance of the facilities. Simultaneously, the staff of Elecgalapagos S.A. will be trained in all activities related to these new technologies, and, at the end of the trust term, the local company will have ownership of all property assets. Ecuadorian contractors have also had an excellent opportunity to be involved in carrying out the work with cutting-edge technology.

Mr. Luis Vintimilla
San Cristobal Wind Project
General Manager

Will the island's electricity users pay more for this clean energy?

No. The rate the final users pay is regulated by the National Electricity Council (CONELEC), and will not be affected by the start-up of this new renewable energy source.

How is the project's sustainability guaranteed?

Its sustainability is guaranteed by the payments received for the energy generated and sold by Elecgalapagos S.A. Therefore, it is important for the distribution company to maintain an adequate administrative and financial profile to ensure that it fulfills its obligations. This is not a for-profit project; thus, the income from the sale of energy will be used exclusively to finance operational and maintenance programs, environmental management plans and provisions for reinvestment in the facilities themselves.

What other elements are included in the Project?

Through a complementary donation by the e8, a number of photovoltaic panels have been installed and connected to the grid on San Cristobal. These panels represent an additional source of clean energy and will serve to train the staff of Elecgalapagos S.A. in this technology. In addition, a training program on efficient energy use has been conducted for high school students on Isla San Cristobal.

Sustainable Development Footprint

Environmental impact assessment

Miconias bushes in the San Cristobal highlands

Since the inception of the Galapagos project, extensive environmental field studies were undertaken by the e8 experts and conducted in collaboration with the Darwin Foundation and the Galapagos National Park (GNP).

Due to the project location in the Galapagos Islands protected World Heritage Site, specifically in the influence zone of the Galapagos National Park, and in order to secure the required Environment license, the Galapagos Wind Project was required to develop a Definitive Environmental Impact Assessment (EIAD).

In the early investigations, it was determined that detailed field studies were needed with respect to the Galapagos Petrel, a bird species largely decimated and currently classified as 'critically endangered' by the World Conservation Union (IUCN). Due to the presence of active Galapagos Petrel nests, and the endemic plant species, Miconia, on the originally proposed wind site San Joaquim, other potential project sites were to be considered for the wind park. El Tropezon, a hill located in an active agricultural area, was identified as the site offering the least impact on the bird species and where fewer Miconia plants exist.

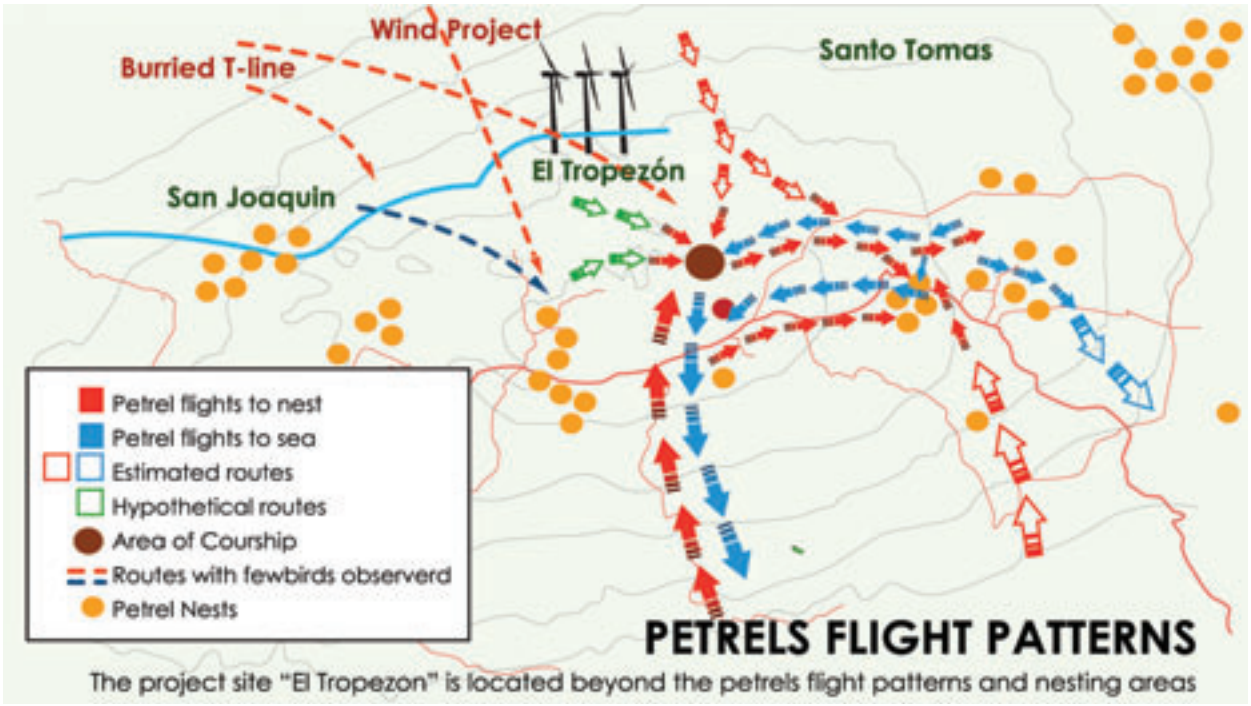
Based on input from the Galapagos National Park and the experts of the Charles Darwin Research Station, the e8 team agreed that more studies were required to analyze the Galapagos Petrel flight pattern in the vicinity of the project site. Studies on the Petrel's reproduction cycle were undertaken to determine the seasonal presence and the reproductive success of the endangered species. The results of this study were included in the final report from the Galapagos National Park.

The Petrel flight pattern studies were then conducted for one year in collaboration with GNP, including the development of a comprehensive monitoring programme of the petrel flight patterns, using a combined methodology of night visual observations with night-vision devices and sound recording visual observations.

Petrels nest in the San Cristobal highlands

The results of this monitoring were reviewed by a committee composed of recognized ornithologists who formed a Bird Review Committee. Ornithologists from the Charles Darwin Research Station, the Catholic University of Quito and the Ecuadorian Ornithological Corporation participated in the Bird Review Committee and were mandated to review the results of the flight pattern

Miconias being protected during civil works



monitoring and make recommendations with regards to the wind project.

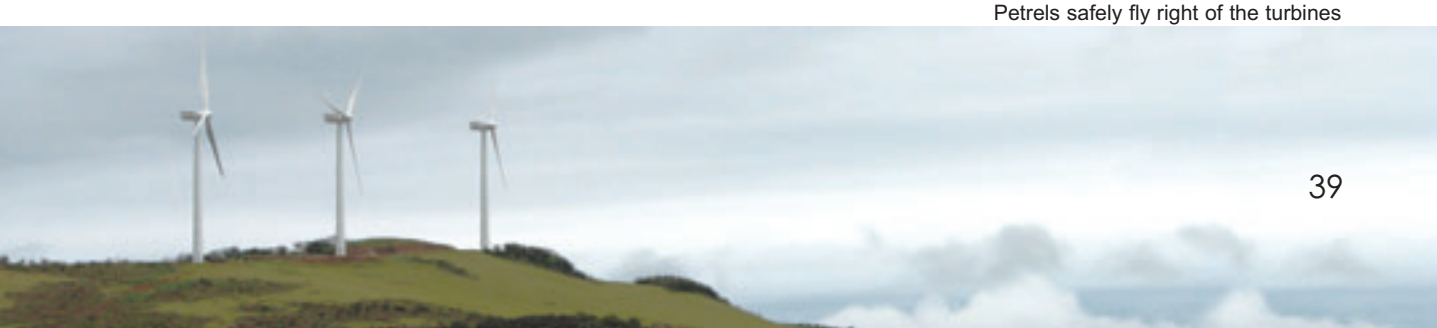
The e8 agreed that another season of bird monitoring would be beneficial to better determine the potential impact of the Wind Project on the Galapagos Petrel. The study was done in collaboration with the e8, GNP and CDRS from June 2004 to October 2005.

Social consultations were undertaken throughout the development of the IEA through public hearings held to discuss the framework of the EIA study, the preliminary results and mitigation measures.

All results of these studies, consultations and the various recommendations of the Bird Review Committee with respect to the petrel led to the establishment of an Environmental Management Plan (EMP), as part of the Final EIAD, which contains mitigation measures and enhancement in conformity with the Environmental Regulations for Electrical Activities (EREA), the CONELEC guidelines and Ecuadorian Laws.

The Environmental Management Plan was elaborated to evaluate the potential environmental impact of the Galapagos San Cristobal Wind Project and to identify the programmes to be implemented during the different phases of the project to minimize any potential impact. The programmes for implementation identified by the EMP included the following actions during the development of the project: adapting the wind turbine location (Design phase), transplanting the endemic Miconia plants found on the construction areas and road paths (Construction phase), handling waste materials and fluids and implementing thorough disposal procedures (Operation and termination phases).

Petrels safely fly right of the turbines



Petrel bird monitored by bird expert and e8 consultant for the Petrel Protection Pogramme

The Petrel Protection Programme

The Wind Project's environmental management plan (EMP) includes a Petrel Protection Programme, the objective of which is to help increase Petrel populations in the archipelago. This initiative consists of various programmes conducted to help control rats and other Petrel predators, control invasive plant species that crowd out plants that support the Petrel, protect habitats, and ensure long-term scientific monitoring of the Galapagos Petrel bird's well being.

Local NGO's, along with the Bird Review Committee established during the project's Environmental Impact Assessment phase, will continue to work in collaboration with the San Cristobal Wind Project team, after the project's commissioning, by providing continuous scientifically-based advice and guidance.

The Galapagos Petrel monitoring and enhancement activities, generally described in the EMP, include:

- Monitoring and Control of Petrel's nesting sites.
- Reducing predator populations.
- Removal of invasive plant species and other habitat enhancement activities.
- Land purchase or easements for nesting area protection.
- Fencing to keep livestock out of nesting areas.
- Removal of abandoned antennas.
- Operational control measures for wind turbines.

Yearly budget values were identified in the EMP for measures related to the Petrel bird protection during the expected 20-year operating period of the wind turbines.

The yearly budgets would be applied toward the most effective monitoring or enhancement measures based on feedback from field monitoring and recommendations by the Petrel Protection Committee and accepted by the Commercial Trust Fund/ EOLICSA.

Field measures undertaken in 2006 included nest monitoring, searches for additional Petrel nesting areas, rat control and invasive vegetation clearing. A direct impact on nesting success of the Petrel was observed during this period in areas where rat control was applied. It is anticipated that this trend should continue.

During the operational period of the wind turbines, a systematic and scientifically-based program will be conducted to monitor the wind park site for avian mortality and other species mortality (such as bats). The methodology and monitoring results will be shared with the Petrel Protection Committee and other local stakeholders. This will allow adjustments or new steps to be considered if unacceptable levels of mortality are found.

Presentation of the Environmental Managment Plan monitoring results: Klaus Baumann (e8) and Jim Tolan attending

The mortality monitoring program was initiated in September 2007.

Registering The Galapagos Wind Project under the Kyoto Protocol's Clean Development Mechanism(CDM)

Wind Park on San Cristobal Island

The Clean Development Mechanism (CDM), an innovative cooperative flexible mechanism initiated under the Kyoto Protocol, is designed with the dual goal of assisting developing countries in achieving sustainable development (SD) while supporting industrialized countries in achieving compliance with their greenhouse gas reduction commitments.

The e8 San Cristobal Wind Project has been planned as a CDM Project since its initiation. The Jessica fuel tanker accident in 2001, which resulted in large oil spills into the ocean waters surrounding the Galapagos islands, a UNESCO-protected world heritage site, was a trigger for the initiative to introduce renewable energy options in the Archipelago. The idea of developing renewable-energy-based power generation in the Galapagos Islands was initiated with the objectives of displacing diesel-powered electricity, helping to reduce greenhouse gas emissions and the risk for equally devastating diesel-fuel tanker spills in this highly protected environment, while contributing to local sustainable development.

Wind project staff sharing experience with UNDP and Ministry of Electricity staff at the wind park

The Ecuadorian Ministries of Environment and Energy have paved the formal and legal ways necessary to develop CDM projects in Ecuador, and Ecuador's National CDM Promotion Office (CORDELIM) has assisted the project team in obtaining national approval for the e8 Galapagos Wind Project's CDM registration.

The formal project cycle leading to the official registration as a CDM project at the United Nations Framework Convention on Climate Change (UNFCCC) Executive Board is a long procedure starting with the elaboration of a Project Design Document (PDD) demonstrating compliance with national and international requirements. The core of this document consists of demonstrating the prospective CDM project's sustainability, a baseline study and the presentation of the project's monitoring plan for emissions reduction. For the e8 Wind Project, this document has been validated by an independent consulting company, and developed along with a public stakeholder consultation required by the registration process. The overall procedure, which took about one year, has been cleared for the Wind Project to be officially registered as a UNFCCC CDM Project.

Project Replicability

The Galapagos Wind project will provide a critically needed road map for similar future renewable energy projects. The project model emphasizes the involvement of local stakeholders and features an innovative knowledge-sharing approach aimed at widely disseminating the lessons learned from this project, both in-country and globally.

Undoubtedly, the project development process has contributed to the education of the local Ecuadorian electricity power company Elecgalapagos, the e8, UNDP, national and local authorities, about the intricate complexities of such an ambitious renewable energy project. The lessons learned, especially on the practical aspects of the project

Wind turbine during installation process

such as the establishment of Independent Power Producers (IPP) to provide electricity generated from renewable sources, will ease the way for future re-electrification projects in other Islands and elsewhere.

Also, the experience of planning and executing the Environmental Impact evaluation required by and associated with this type of projects could similarly be used to reduce the obstacles and costs for future similar projects.

In addition, the capacity of Elecgalapagos to negotiate Power Purchase Agreements with Independent Power Producers, to carry out operation, maintenance and dispatching activities in hybrid power systems and to provide quality service to its consumers will be strengthened. Finally, Government institutions like the Ministry of Energy and Mines and CONELEC will be better prepared to create a policy and regulatory framework governing the electricity sector.

Many of the project's approaches and components are transferable to small island states that are similarly isolated from mainland electricity generating systems and grids.

Project developers and governments focused on mainland electricity supply and delivery would be able to use and replicate the approach undertaken for the development of the Galapagos Wind Project.

The Galapagos Islands are known worldwide and this visibility is even higher now that UNESCO declared the islands an endangered World Heritage Site in June 2007. As a result of this increased visibility and global commitment to protecting the Galapagos endangered world heritage site, the e8 project has the potential to become a model for renewable energy project development aimed at environmental protection and the promotion of sustainable development, in the Galapagos, the Latin American region, and the world.

Wind turbine with local farm cows

The project can be replicated anywhere in harmony with nature

Interview with Mr. Pedro Zapata Rumipamba, Mayor of San Cristobal:

San Cristobal's development strategy: a sustainability model for Ecuador

In recent years, San Cristobal Canton has undergone major changes in infrastructure, architecture and administration. What led to this awakening?

We are developing and implementing projects with a strong environmental component because we are concerned about maintaining adequate environmental standards for the management of the islands. For example, we have a solid waste project, an ecological dock and boardwalk project (the latter named after Charles Darwin), and an operational center for the fishing sector, specifically designed to support this activity. These are some of the projects we are developing, and the San Cristobal Wind Project fits perfectly within this vision. We are very pleased to support the clean energy project for San Cristobal, which will help the island become an attractive tourist destination.

How has the San Cristobal community responded to the start-up of the first wind farm in Ecuador and the only one of its kind in a natural protected area?

As the local counterpart and main beneficiaries, we will of course adopt this internationally prestigious project as our own. Considering that Galapagos is now experiencing a series of problems related to the lack of environmental zoning that should have been applied here, this project will enhance the image we project overseas and in mainland Ecuador. Therefore, this project and others like it, will certainly receive our full support.

Could it be said that the conservation of the natural environment is central to the socio-cultural dynamics of San Cristobal's population?

Clearly, if we did not have an environmental culture here on the islands, we would not have attached the same importance to the project. The San Cristobal Wind Project and others like it that lead to social development without damaging the natural environment, will always be welcome on our island.

Specifically, what do the San Cristobal's people think about the Wind Project?

The perception the islands' inhabitants have of the Archipelago's administration, as well as our current perception of this cantonal municipality, is basically related to adequate resource management for the sustainability of the Galapagos Islands, and of Isla San Cristobal in this case. We will take ownership of this project and work to support its future sustainability.

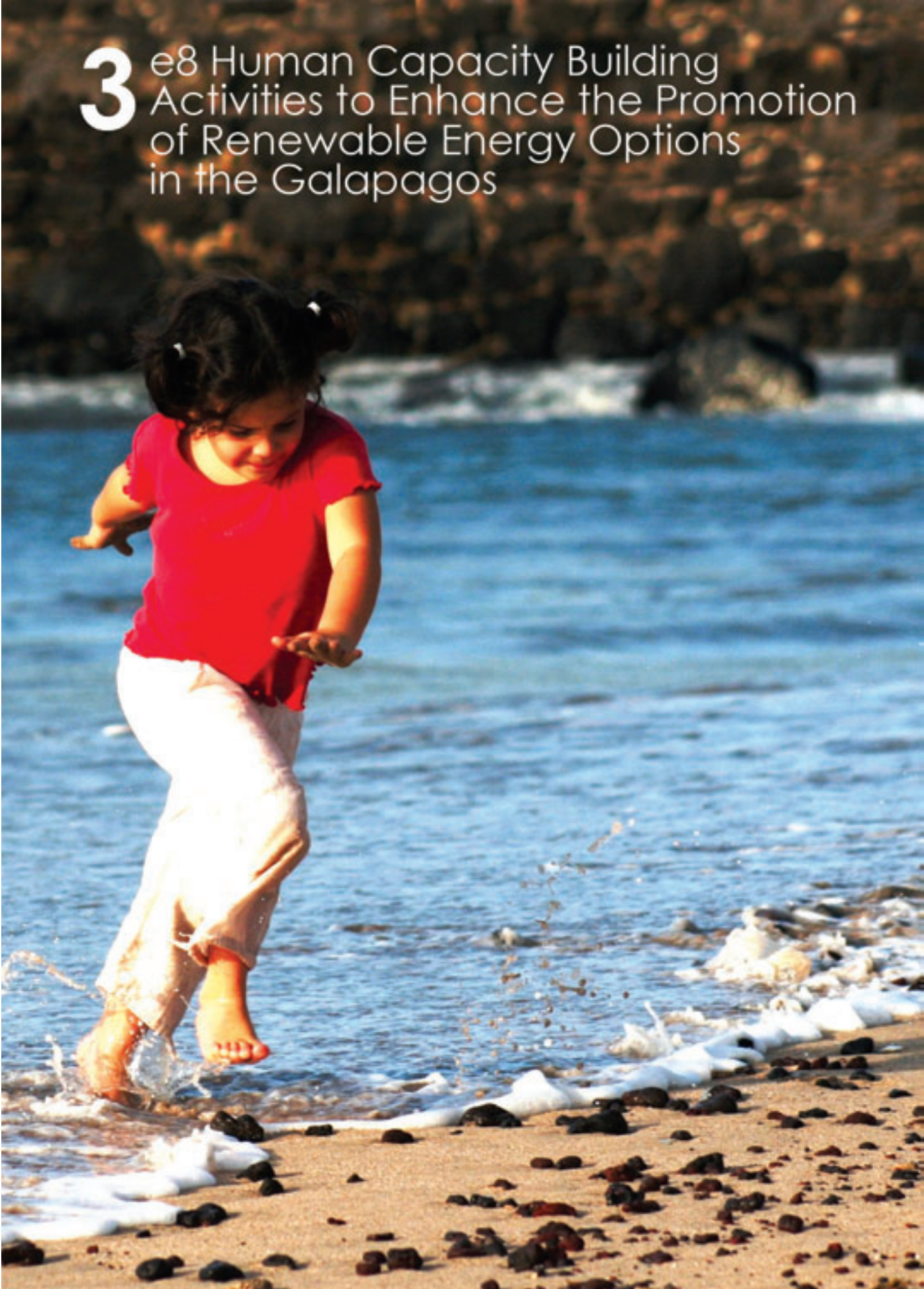
With the San Cristobal Wind Project, this island has reached a milestone in the history of national electrification by becoming the site of the country's first wind farm. How does that feel?

Speaking in the name of the people of San Cristobal, we are very grateful and are committed to take good advantage of this historic event. On behalf of and in representation of this community, I would like to thank the e8 group for having taken the initiative to implement this wind project. We also extend our thanks to the National Government, through CONELEC, and Elecgalapagos, partially owned by the Municipal Government. Thank you for choosing San Cristobal as the place to launch this new phase of national electrification of this island.

"Ensuring a promising future for generations to come depends on how we care for the environment today"

Mr. Pedro Zapata Rumipamba
Mayor of San Cristobal

3 e8 Human Capacity Building Activities to Enhance the Promotion of Renewable Energy Options in the Galapagos



The e8, in addition to the implementation of the San Cristobal Wind Project, has developed a complementary project aiming at building human capacity to manage solar electric (photovoltaic) systems, advancing student education and research in energy efficiency and hybrid wind-diesel applications, and supporting the development of a renewable energy services management entity in the Galapagos archipelago.

In collaboration with SolarQuest, a not-for-profit educational organization specialized in renewable energy education worldwide, the e8 has developed the Galapagos Solar PV human capacity building project consisting of:

- The educational micro-solar long distance learning programme.
- The development of solar photovoltaic installations complemented by a training programme to build the Galapagos' human capacity in solar PV renewable energy systems.

Local workers in training for solar panels installation

The micro-solar long-distance learning programme:

Educating the youth on renewable energy options and energy efficiency The MicroSolar Distance Learning Programme is designed to promote long-distance learning and telecommunications based on photovoltaic (PV) installations in areas located beyond the reach of existing power and communications grids. Solar panels have been installed in schools to provide lighting, power computers, and Internet connections.

What do students learn about?

Students in the MicroSolar Galapagos program apply computer science skills to learn about energy efficiency and renewable energy technologies, with renewable energy technologies, with the objective to serve the community and contribute to the promotion of sustainable energy development. MicroSolar resources are also available for teachers and students to improve learning in all subject areas.

How does this improve learning?

MicroSolar opens an unlimited window of opportunity for education. Teachers and students can access on-line libraries, encyclopedias and distance learning programs. Much of the World's knowledge is now available to students through the Internet.

How do students serve their communities?

In the Action, Communications, Technology, and Science (ACTS) program in 2004 and 2006, students from the Colegio Tecnico Ignacio Hernandez (CTIH) in San Cristobal, each provided 200 hours of community service to monitor and analyze the Island's electric grid in order to research the potential of reducing electricity demand and consumer energy costs through energy efficiency.

The grid-connected photovoltaic system in San Cristobal is a complement to the hybrid wind-diesel system

How did students do this?

With funding from e8 companies (American Electric Power, Ontario Power Generation, and Hydro-Quebec), SolarQuest® worked with students and teachers at CTIH to collect and analyze data from common household appliances. Over the Internet, Enel, the Italy-based e8 member company, retrieved and processed the data in a computer simulation model to verify the accuracy of the students' research.

What did students learn?

Students applied the scientific method and acquired critical thinking skills. They learned to collect and analyze data and to represent it graphically. They also learned practical knowledge, including such information as the amount of energy waste from inefficient electric appliances in the Galapagos.

What did they learn about energy waste?

They learned that nearly 36% of the refrigerators in the Galapagos consume energy 24 hours each day – they fail to shut off, and that refrigeration represents 68% of residential energy consumption on the Islands. They also learned that this energy efficiency waste costs consumers and the government nearly $1 million dollars each year, which is equal to the Galapagos education budget from the federal government.

What can be done about this?

The students at CTIH proposed the implementation of an energy efficiency program to replace inefficient refrigerators and lighting with high-efficiency appliances. e8 company, Enel, supported this analysis, and verified that energy cost savings could pay for the new appliances in just over two years.

Has their proposal been accepted?

Students have not yet submitted a formal proposal to the government, as subsidies for energy would need to be a part of the payment for new appliances; this requires changes in public policy. Future MicroSolar students will learn about public policy and project financing.

What is the future of MicroSolar?

As new skills are taught – computer programming, content development – students will lead the Galapagos to a global information economy based on science education content, and the Archipelago will become an ecological observatory and Internet-based research laboratory connected to classrooms worldwide.

Introducing Solar Energy Options to Galapagos

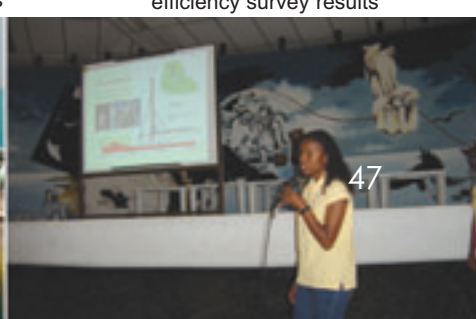
Students of the MicroSolar programme presenting the results of their research on local energy consumption to e8 representatives

The e8's Solar PV project in the Galapagos aims at introducing solar energy options to the Archipelago, and features the development and construction of two solar PV systems, totaling approximately 12kW, on the Island of San Cristobal.

6 kW solar panels installed on control room roof

Project team with high school students

High school student sharing efficiency survey results



The project is complemented by a human capacity building program the objective of which is to provide training, expertise and education to the local power company employees, and community at large, on the development, construction and maintenance of solar PV systems. The PV panels were supplied by the Foundation for Environmental Education (USA), under its worldwide 'Learning from Light' program.

What are the options for solar energy in the Galapagos?

Solar power generation – based on photovoltaic technology– is a viable technology option for electricity production in the Galapagos. However, today, the cost of small and large scale applications of solar electricity and the lack of financial incentives remain a barrier to the wide spread of renewable energy in the archipelago. In the future, however, government incentives will likely be available for solar electric systems in the Galapagos and throughout mainland Ecuador.

Then why is the e8 installing solar energy systems in the Galapagos?

With the installation of two 6 kW PV systems, one at Escuela Pedro Pablo Andrade and the other at the central thermal power plant, the e8 is providing critical experience for Empresa Electrica Provincial Galapagos (EEPG), the local power company, in the installation, operation and maintenance of solar energy systems. The e8 is helping EEPG prepare for the future when solar energy will be economically viable.

Why did the e8 install solar energy at the school?

In addition to the training opportunity for EEPG, the PV installations at Escuela Pedro Pablo Andrade offers students and the general public an introduction to solar energy systems. The school is partnering with the e8 and SolarQuest® to provide educational opportunities to students in all grade levels of school and to the general public.

What kind of educational opportunities are being provided?

Students will learn basic concepts of solar energy, such as how solar energy is converted into electricity. This will be a hands-on activity supporting the core science curriculum at Escuela Pedro Pablo Andrade. A portable solar energy education display that can be disassembled and reassembled will be available o schools and community centers throughout the islands. e8 companies provide this type of education to schools in their countries.

What will students teach the public about solar energy?

As a service learning project, students will teach the general public about the basic concepts of solar-based electricity generation. They will also provide information about the components of a solar electric system, like solar cells and inverters, and inform the public about applications of solar energy for their homes and businesses.

What are the other solar renewable energy technologies that are appropriate for the Galapagos?

Solar thermal – heating and cooling – is important. Solar hot water heating systems can replace the need for electric resistance hot water heaters, and save consumers money. Solar cooling, including shading devices and ventilation can reduce the need for air conditioning.

Will these technologies be available to the Galapagos' residents?

Yes, in the future. The e8 and SolarQuest® will work with EEPG to introduce these technolo-

gies in order to improve the positive impact of the e8 project reducing fossil fuel consumption for electricity generation. However, this requires human capacity building for personnel at EEPG, consumer acceptance of new technologies, and financing.

How will this be accomplished?

SolarQuest® will continue to work with EEPG to provide human capacity building for solar energy technologies, and will continue to work with schools and the general public to advance solar energy education.

What is the future of solar energy in the Galapagos?

The e8 is providing important leadership to achieve energy security in the Province and to protect the biodiversity of the archipelago. This leadership, in partnership with the United Nations and the Government of Ecuador, is making it possible for clean energy options to play a vital role in achieving sustainable development in the Galapagos.

Solar panels installed on top of the roof of Pedro Pablo Andrade School in San Cristobal

Concluding Message

The 2,400-kW Galapagos Wind Project is an example of the significant role played by UN-Public-Private partnerships to promote sustainable power generation and distribution using renewable energy options in small islands such as the Galapagos. The Wind Project demonstrates how such partnerships can effectively contribute to the protection of endangered ecosystems and the reduction of green house gas emissions while simultaneously enhancing economic and social sustainable development.

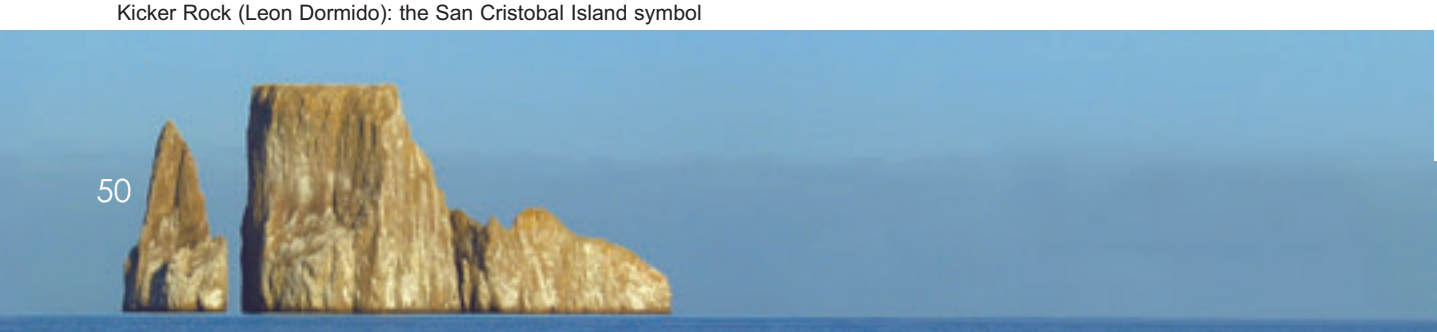
The complementary educational and training programmes on renewable energy options and energy efficiency use, initiated along with the Wind Project have significantly contributed to the local community's increased awareness and knowledge of sustainable energy options and the importance of cost-conscious electricity use and energy-efficient consumption. Through these programmes, the e8 has highlighted the importance of human capacity building and public education for the effective local acceptance, development and spread of renewable and clean energy technologies.

Bringing energy to the 2 billion people currently without access to electricity around the world and developing clean power generation to mitigate climate change and its negative impact on human development and the global environment have been at the core of the e8's mission and actions.

The renewable energy projects implemented by the e8 in the Galapagos are a response to the call for action addressed to the electricity sector at the World Summit on Sustainable Development. At the Summit, such concrete actions were identified as a priority to alleviate energy poverty through increased access to clean energy leading to sustainable development worldwide.

San Cristobal Wind Farm in operation

Kicker Rock (Leon Dormido): the San Cristobal Island symbol



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Winter 2008