



Dissemination: a guarantee for success

As the transfer of knowledge is crucial in such innovative projects, dissemination activities as varied as leaflets, brochures, publications in relevant journals and technical press, website development, explicative DVDs, organisation of workshops and seminars, presence in conferences and exhibitions and awareness campaigns will take place. Moreover, at the end of the project, two technical visits will be organised. The target groups will be composed of local authorities, energy planners, consumers associations, industry and private investors, tourism industry and energy companies, interested citizens from remote regions and islands within and outside of Europe, and EU representatives.

Replication: Crete and Madeira the first of a long series?

Hundreds of islands worldwide could benefit from the results of this project. As a consequence of the planned activities, the energy independency and quality of life on isolated islands could be increased (more than 13 million Europeans live on islands, which account for more than 5% of European territory).

There is a strong willingness for cooperation with regions where comparable projects could be realised. For instance, feasibility and economic studies for the development of similar Wind-Hydro Power Station on Crete and Madeira are already in progress. As a project partner, and in collaboration with INSULA (International Scientific Council for Island Development), NTUA (National Technical University of Athens) occupies a strategic position in the identification of Greek islands where the project could be replicated. On a worldwide level, cooperation will try to ensure the replication of the system on non European islands and islands belonging to developing countries. A tentative list of potentially interesting islands has been drawn up by INSULA of which about 60 islands seem to correspond to the set criteria.

Special thanks to Artenara Fotos, Kimmo Nordström and Carsten Schauer for permission to use their photographs.

Graphic design by Susanne Klein



Besides ITC, the project coordinator, the other **project partners** are: the Cabildo Insular de El Hierro (Canary Islands, Spain), the National Technical University of Athens (NTUA, Greece), the International Scientific Council for Island Development (INSULA), the Regional Agency for Energy and Environment of Madeira (AREAM, Portugal), the Regional Energy Agency of Crete (REAC, Greece), and the engineering company E4Tech (Switzerland).



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El Hierro

El Hierro, towards a 100 % renewable energy supply



El Hierro 100% RES island

Wind-hydro power system

Integration of renewable energy sources





Linking innovation, finance and technology

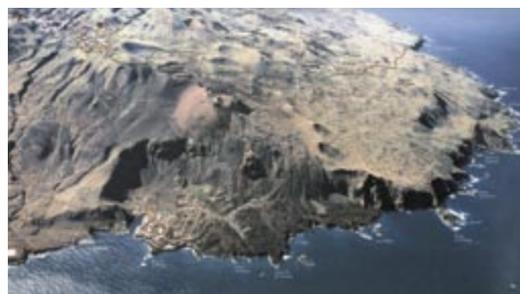
Most islands depend heavily on imported fossil fuel. Security of supply at affordable prices may not be guaranteed in the future, jeopardizing all sustainable development efforts. Renewables, in particular wind and solar energy, offer islands a “clean” abundant supply that can be reliably harvested at financially competitive levels. The understanding of the relationship between sustainable development and the innovative management of renewable energy is the central objective of the El Hierro project, which will demonstrate that it is now possible for islands to achieve energetic independence.

Sun, wind and water, the new allies of El Hierro

El Hierro, the smallest island of the Canaries, is staging one of the most ambitious island projects regarding energy self-sufficiency through the use of renewable energies. In a few years, El Hierro will become one of the first islands in the world to meet its energy demand using RES (Renewable Energy Sources). Considered as one of the most audacious actions of the strategy established in the European Commission White Paper on Renewable Energies, the project is already a reference for other islands, such as Crete and Madeira, and has become a strong example of the “Island 2010” initiative promoted by the ALTENER programme. The 100% RES project is also a key issue of the “Sustainable Development Plan” defined in 1997 by the Island Government of El Hierro, which has proved to be even more relevant since El Hierro was declared a “World Wide Reserve of Biosphere” by UNESCO in January 2000. It is a most singular project, featuring high replication possibilities, which demonstrates that a 100% RES future is already a reality for islands.

To reach this challenging objective, different programmes focusing on energy saving, 100% RES for electricity production and transport are to be implemented. With the financial support of the DG TREN of the European Commission, a consortium of 7 partners, coordinated by ITC (Instituto Tecnológico de Canarias), are carrying out a project that focuses on the “100% RES for Electricity Production” programme. The most innovative part of this programme is the development of a Wind-Hydro power station, which is an original concept that combines wind power and hydropower, using water as an economic way of storing energy. Furthermore, and in order to demonstrate that the synergies between different RES can contribute greatly to increasing RE penetration into weak grids in isolated areas, PV, solar thermal and biomass programmes will also be implemented.

During the first phase, an important part of the project is devoted to the construction and monitoring of the Wind-Hydro power station on El Hierro, but also to feasibility and economic studies for the development of similar Wind-Hydro power station, initially on Crete and Madeira and later, on other islands worldwide that are appropriate for the replication of the system. On a less technical level, tasks such as the integration and involvement of the island population (acceptance of the system), socio-economic research and knowledge sharing will be implemented.



Wind and water: the perfect synergy

With great ascents and high wind energy potential (Trade Winds), El Hierro proves to be a very suitable place for the implementation of a Wind-Hydro power station; it is also the first Wind-Hydro power station that will be providing close to 80% of the electricity demand of a totally isolated area.

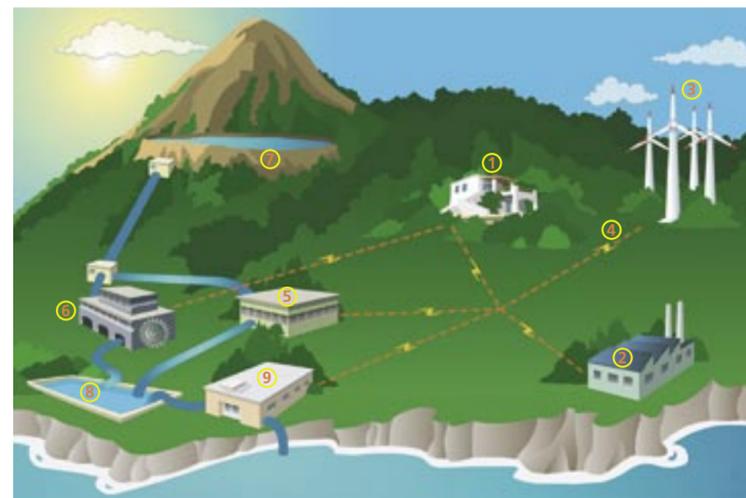
The major advantage of such a combination is that the system can overcome the usual problems of discontinuity and power fluctuation caused by the intermittent characteristic of the wind resource. When the energy produced by the wind farm exceeds the demand, the surplus is used to pump desalinated water in a reservoir situated 700 m above sea level. Conversely, if the energy produced by the wind farm is insufficient to meet the demand, the water stored in the upper reservoir is released through the turbines to a lower reservoir, converting the potential energy of the water into electrical energy. In this way, thanks to the potential energy storage and the controllable power output of the hydro turbines, it is possible to establish a stable grid in terms of frequency and voltage, where the production matches the demand at any time.

As the water-energy binomial is an essential aspect of the sustainable development strategy of the island, the system also includes a water desalination plant, not only to fill the reservoirs and compensate for the evaporation losses but also to produce water for irrigation and domestic use.

It has been estimated that a maximum direct wind energy penetration into the grid of 30 % could be achieved. Until now, no isolated island (weak grid) has had such a big direct wind contribution. Therefore, the island will be a study of grid stability issues and the results will contribute to defining the real limit of wind penetration. As well as the Canary Islands, all isolated islands, in Europe and worldwide, could benefit from the results of this experience.

- ① **Population:** more than 10000 inhabitants for a surface area of 276 km²
- ② **Conventional power station:** 8,3 MW diesel fired system
- ③ **Wind farm:** 9,35 MW installed power
- ④ **Maximum penetration rate of wind energy for direct consumption into the grid:** 30%
- ⑤ **Pumping station**
- ⑥ **Hydropower station:** 3 x 3,3 MW Pelton turbines, able to operate from 10% to 100% of their power capacity while keeping the same efficiency
- ⑦ **Upper reservoir:** Height: 700 m above sea level // Capacity: 200000 m³, coverage of the energy demand during seven consecutive days without wind (Beyond this, the existing diesel power station will take over to meet the entire demand).
- ⑧ **Lower reservoir:** Capacity: 200000 m³
- ⑨ **Desalination plant:** Capacity: 5 to 10 m³/day. It fills the reservoirs and compensates the evaporation losses. The plant will also provide water for irrigation purpose and other use.

The wind-hydro power station: How it works?



A people-oriented energy management style

A major innovation of the present project is that, contrary to what has been done until now regarding electricity management (the utility owns and exploits the power station as well as the wind farm and sells/distributes the electricity), it has been decided that a consortium would be introduced to own and administer the Wind-Hydro Power Station. The company was baptized Gorona del Viento El Hierro, S.A. and the shareholders and their respective contributions were defined in an agreement in December 2004. This consortium includes the Island Government of El Hierro (representing political commitment, which is essential for inhabitant integration in the project), the Canary Islands through ITC and the power utility (UNELCO-ENDESA).

Acceptance of the project by the population is essential. Therefore, as well as the implementation of several workshops, and awareness campaigns, the inhabitants will also have the opportunity to be directly involved in the project as co-owners of the Wind-Hydro Power Station. A number of the Island Government-owned shares will be divided into smaller ones giving El Hierro SMEs and every islander the possibility of part-ownership, which is expected to create interest and to effectively involve the population in the project.

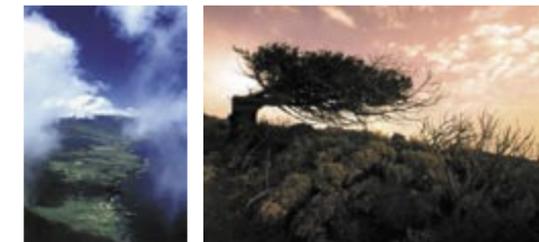
Hot water and electricity from the sun

Due to its ideal location, El Hierro experiences exceptional irradiation conditions and effectively harnessing solar energy is a key part of the 100% RES strategy.

Following an ITC initiative, a local company has been created to supply and install PV systems and a programme called “10 PV roofs” has been initiated. The quantitative objective of this programme is to install 50 kWp by the end of 2005. In order to do so, ten 5 kWp systems are being installed, with a priority given to public buildings. As a result, these systems will increase the percentage of RE into the grid and will produce energy during the daytime, when the electricity consumption is higher.

Of course, the 100% RES strategy does not only cover electricity production as solar energy can also be used to produce hot water. Therefore, a solar thermal energy programme, PROCASOL, has been launched in order to promote solar thermal energy installations on El Hierro and in the Canary Islands. The aim of this programme is to substitute electrical heaters with solar thermal systems in order to reduce the total electricity demand for domestic hot water and, in turn, smooth the load profile of the island. The programme combines direct funding for the investment and the financing of the system at a zero interest rate as well as several measures such as guarantees for the collectors and their installation and maintenance. In order to ensure the success of the programme, ITC successfully promoted the creation of a local company devoted to, amongst other matters, the installation of solar thermal systems. Although it has been estimated that 2500 m² of collectors would be necessary to cover the entire potential market, the quantitative objective within the first phase this project is to reach an installed collector area of 500 m² by the end of 2005.

Whether for the photovoltaic systems or the solar thermal collectors, it is important to create a network of local professionals who will be able to fix and maintain the installation and provide a high-quality after-sale service. To facilitate this, several training sessions dedicated to electricians (PV) and plumbers (solar thermal) have already been organized.



Biomass for biogas and much more

In terms of biomass energy, El Hierro has a strong potential, in particular for biogas production. Resources such as sewage sludge, animal waste and the organic part of MSW (Municipal Solid Waste) as well as organic industrial waste (slaughterhouse and dairy) could be used in biogas plants. The combined treatment of non-wood waste in an anaerobic centralised plant is the preliminary proposal of use but the recycling of used oils and energy crop production will also be studied (production of biofuels). In the second phase of the project, the biofuels or biogas could also substitute the diesel used in the power station or in some transports, whereas the waste from forests and plantations (banana, pineapple) could be used directly or indirectly as fuel for heat production, reducing the consumption of electricity and butane.