

Development of RES Investment Projects in Small-island Biosphere Reserves

Sustainable energies in small-island biosphere reserves

Biosphere reserves are protected areas of representative ecosystems that have been recognised within UNESCO's MAB (Man and Biosphere) Programme for their importance in providing the scientific knowledge, skills and human values needed to support sustainable development. Among the sites contributing to the international network of biosphere reserves and the World Heritage List are a number of small islands and archipelagos. Island communities around the world are almost totally dependent upon a steady supply of petroleum products. The cost of fuel and the threat of shortages and concerns about environmental impact (exhaust fumes, oil spillage, etc.) recently prompted the assessment of energy needs and created an incentive to develop indigenous energy resources. Because of the variety of situations that exist, from large islands with several alternative energy options to small islands with very limited resources, there is no generic solution to energy independence in island communities. Each island must utilise the energy resources that are available to it in an economically, environmentally, and socially acceptable way.

The project's context: Economic activities and energy situation of the islands

The targeted actions planned in this project are to be developed in the following small-island biosphere reserves: Minorca and Lanzarote (Spain), the Guadeloupe Archipelago (France) and the Galapagos (Ecuador), which was chosen because it is also a World Heritage Site and has a special interest for different EU private and

Minorca, Lanzarote, Guadeloupe and Galápagos are protected areas of representative ecosystems of the Earth (MAB programme of the UNESCO).

The Altener project Development of RES investment projects in small-island biosphere reserves, developed in these islands, aims to stimulate the take-off of renewable energy resources, and thus to contribute to meeting the challenge presented by sustainable development. Wind power, waste management, autonomous photovoltaic electrification and solar powered air conditioning projects are underway in these regions. At the same time, the development of solar thermal energy projects within the hotel sector is an important common activity in all these areas. Together with compliance with other environmental criteria, will permit these establishments to obtain the ecolabel "Biosphere Hotels". The certification "Biosphere Hotels, Quality for life" specifically covers hotel establishments located in Biosphere Reserves and their buffer areas, or Natural World Heritage Sites.

The projects are being developed in the framework of an Implementation Plan, which involves all the active parties in the promotion of renewable energies who constitute an Implementation Group in each island.

On the other hand, the project focuses on the promotion of co-operation at an inter-island and international level particularly in the domains of formation, information, transfer of technology, as well as in the dissemination of the RES projects implemented.

public institutions. Although these spaces present very different biogeographical situations, they have in common their small size, declaration as biosphere reserves and the important role played by the tourist industry on each of these insular territories. Tourism is, on all four islands, the dominant factor in local development policies and an activity capable of imposing the economic and regional development model. With the exception of Minorca, which still maintains certain traditional economic activities and a booming and diversified local industrial fabric, the other islands or archipelagos, especially Lanzarote, are clearly dominated by a single industry: tourism.

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Table 1, shows some of the principal characteristics of the tourist sectors of Minorca, Lanzarote, Guadeloupe and the Galapagos.

Island	Annual visitors	No. beds	Seasonality
Minorca	1,4 M	65.000	High
Lanzarote	1.5 M	55.000	Low
Guadeloupe	0.7M	8.500	Medium
Galapagos	0.07M	2.580	Medium

Table 1: Characteristics of tourism on Minorca, Lanzarote, Guadeloupe and the Galapagos

The specialisation imposed by tourism on the economies of these islands means that energy capacity is often oversized, as such factors as the seasonality of consumption, sudden changes in markets or the dispersion of demand can all intervene. These aspects, along with the high cost of electricity power generation, created advantageous economic conditions for the development of the renewable energies, principal solar and wind power, but also tidal and geothermal power and the production of energy from solid waste. With regard to primary energy supply, the domestic market on these four biosphere reserve islands and archipelagos is limited to a tiny proportion of renewable energy, and practically the entire primary energy supply depends on the entry of oil. Table 2 shows electricity generation by thermal power stations and the contribution of the renewable energies.

Island	Thermal	PV	Solar Th.	Geoth.	Wind power	Small hydro
Minorc.	120 +247	0.13	2.85	0	0,104	0
Lanz.	566	0.12	2.23	0	179	0
Guade.	1136	4.5	30	23	13	20
Galap.	13	0.009	0.12	0	0	0

Table2: Thermal electricity production and contribution of RES (GWh)

The largest contribution to energy production by the renewable energies is in Guadeloupe and accounts for more than 7% of total electricity produced. This archipelago, like the other Biosphere Reserve islands considered under the project, is characterised by sustained growth of total energy consumption, which reached around 800,000 TOE in 1998. Of this, some 710 KTOE (90%) were based on hydrocarbons (41% to generate electricity, 22% for air transport and 33% for road transport). Electrical energy consumption is 1136 GWh (1998), representing a fuel consumption of 256 kg per kWh generated. In Lanzarote, the most significant contribution by the renewable energies corresponds to wind power, with installed power of 6.4 MW and electricity production of 17.9 GWh. The contribution of solar photovoltaic

energy is much smaller.

Finally, in Minorca and Galapagos the present contribution of the renewable energies to electricity production is accounted for by the production of solar photovoltaic energy by small facilities with power of around 100 kwp.for Minorca and 10 kWp for Galapagos.

Project objectives: Renewable energies in small-island biosphere reserves

This project aims to stimulate the take-off of renewable energy resources, and thus to contribute to meeting the challenge presented by sustainable development. Wind power, waste management, autonomous photovoltaic electrification and solar powered air conditioning projects are underway in these regions. At the same time, the development of solar thermal energy projects within the hotel sector is an

important common activity in all these areas. Together with compliance with other environmental criteria, this will

permit such establishments to obtain the "Biosphere Hotels" ecolabel.

- Review the Action Plans and establish priorities in the field of the renewable energies for the Biosphere Reserve islands, drawing up an Implementation Plan.
- Promote the concept of Biohotel or Biosphere hotels by developing the use of RES in the tourist sector including, specifically, solar hot water production.
- Develop investment projects for electrification using renewable energy sources and waste solid treatment on the Biosphere Reserve islands.
- Harmonise the different initiatives of these small islands in the field of the renewable energies, and to contribute to the implementation of a possible Solar Marketing Programme.

- Promote co-operation on an inter-island and international level, particularly in the domains of formation, information, technology transfer, etc
- Foster the broadest possible dissemination of RES applications in island regions as a result of their implementation in Biosphere Reserves
- Develop funding mechanisms and appropriate institutional and regulation reforms.

Action plans developed

Minorca and Lanzarote have developed a Renewable Energy Action Plan in the framework of the Altener I programme. Guadeloupe has developed a Regional Renewable Energy Plan, approved by Ademe, as well as completing various feasibility studies under the Altener and Save programmes. Galapagos is currently carrying out feasibility studies for the renewable energy-based electrification of the islands and is also carrying out analyses of different alternatives for solid waste management. To define the Implementation Plan all this Action Plans have been reviewed.

Minorca

The Renewable Energy Plan, developed within the framework of the Altener I Program and implemented in close co-operation between the Consell Insular de Menorca and INSULA (International Scientific Council for Island Development), with the technical realisation of the Institut Menorquí d'Estudis and the collaboration of ICAEN, forms part of the general sustainable development strategy for European islands and of the specific lines of action laid down by the Sustainable Development Plan for Minorca.

This RES Plan stipulates that the main RES projects to be developed in the island in order to reduce conventional energy consumption are: 40 MW wind parks, 8000 m² of solar collectors for hot water production, and solar passive and energy saving measures in different sectors.



Lanzarote

Lanzarote offers exceptional climatic conditions for the use of solar and wind energies without discarding other potential resources such as geothermal energy (currently under study), biomass, solid urban waste, wave energy, etc. It is considered of the utmost importance for Lanzarote to increase its level of energy self-sufficiency, where a 6.4MW wind park is already operating on the island. The Autonomous Government Ministry of Industry and Trade has developed the RES Plan (Plan Energías Renovables para Canarias, PERCAN) which provides, as part of the subprogram PROCASOL, for the installation of 36,000 m² solar collectors in 6 years, introducing different modalities for financing the installations. Also 140 MW wind and 44 MW from solid waste. Finally, it should be mentioned that to guarantee the objectives frame of the Biosphere Reserve, Lanzarote has an instrument of regional organisation (Plan Insular de Ordenación del Territorio) and has developed a strategy for the sustainable development of the island.

Guadeloupe

Like most small Caribbean islands, Guadeloupe has no fossil energy resources. Nevertheless, the energetic independence rate now stands at 10% thanks to the initial effects of the Regional Plan for Energy Control. The public institutions now seeks to increase the development of RES through new projects (35 MWwind farms in Marie Galante and Nord Grande Terre, husks/ coal power plant, waste incineration plants...). The potential for the development of RES remains vast. The most recent study showed that RES could supply 25% of electricity demand by the year 2006.

Galapagos

The Ecuadorian government, the institutions of the Galapagos and a number of international bodies are currently promoting

solutions for the electrification of the islands which take maximum advantage of renewable energy sources, both to reduce the risk of environmental impact and to make the Galapagos a national and regional showcase for sustainable development. As part of these initiatives, a project for the electrification of the archipelago based on the use of the renewable energies has been financed by UNDP-GEF in co-operation with the Directorate for Alternative Energies (Dirección de Energías Alternativas, DEA).

Res investment projects to be developed in the islands

The implementation plan for the renewable energies in small-island biosphere reserves project

The principal objective of the Implementation Plan is to analyse the prospects for the renewable energies on each of the islands and to specify and define the actions to be carried out as part of the project. An initial stage in the Plan, summarised above, will involve describing the energy situation on each island and defining the general framework for the implementation of renewable energy projects, identifying those factors which favour or present obstacles to the development of the renewable energies. A second part of the Plan centres on the actions to be developed in the framework of the Altener project for each of the islands and describes how these actions will contribute to the economic and social development of the island and to the preservation of the environment.

To ensure broad local participation in drawing up and managing the Plan, an Implementation Group has been set up on each of the islands, made up of representatives from different sectors of the population, such as hoteliers' associations, institutions, NGOs engaged in environmental action, universities, electricity companies, etc.

The projects: Renewable energies in small-island biosphere reserves

The renewable energy projects will be implemented on each of the four small-island Biosphere Reserves involved: Minorca, Lanzarote, Guadeloupe and Galapagos. The principal action, common to all the islands, is the development of solar thermal energy projects in the hotel sector. These, along with compliance with other environmental criteria, will allow the establishments involved to obtain the "Biosphere Hotels" certificate. Wind power projects will also be implemented in Guadeloupe and Minorca, as well as waste management and autonomous photovoltaic electrification projects in the Galapagos, solar heating, cooling and air conditioning projects in Guadeloupe and projects for the generation of energy from landfill biogas in Lanzarote and Galápagos.

Solar thermal energy in the hotel sector

A total of 35 projects are being developed on the four islands for the production of solar hot water in hotels. As part of the process for selecting the hotels, forms were completed allowing the necessary data to be gathered to carry out a preliminary feasibility study. The first stage of the project involved completion of these studies and the selection of the hotels in Minorca and Lanzarote. The selection process is currently getting under way in Guadeloupe and Galapagos. Table 3 shows the main characteristics of the thermal solar installations proposed.

Island	Nº Hotels	Nº beds	Area solar collect. (m ²)	Energy Prod. (KWh)	Invest. (EUR)
Menorca	7	2842	1459	912.674	613.032
Lanzarote	16	9196	6413	7.090.970	2.343.947

Table 3: Solar Thermal installations of the hotels in Menorca and Lanzarote.

Solar cooling in Guadeloupe

Various experiences in solar cooling have been carried out in the south of France, and a project is being implemented under the aegis of this Altener project for the installation of a solar cooling system at the Hotel Novotel, a member of the Accor chain, on

Grande Terre in the Guadeloupe archipelago. The energy characteristics of this facility are as follows:

- Energy produced by the solar collectors: 240,000 kWh/year
- Cooling energy transferred from the absorption machine: 153,000 kWh/year
- Electrical energy saved: 60,000 kWh/year
- Tonnes of CO₂ saved: 45
- The absorption machine has energy efficiency of 70% whilst the COP of the cooling system is estimated at 2.5.

Wind farms on Minorca and Guadeloupe

Various studies have found high wind power potential at various points of Minorca and the Guadeloupe Archipelago. Within the framework of this project, the construction of a wind farm is proposed in the north of Minorca, as well as the extension of the facility which already exists on La Désirade, in the east of the Guadeloupe Archipelago. The table below summarises the principal energy characteristics of these projects:

Wind farm	Average annual wind speed	N° wind turb.	Inst. pwr.	Elec. Gen.	CO ₂ saved
Sa Talaia Minorca	6 m/s	23	13.8 MW	10,080MW/year	2,626 t
La Désirade Guadeloupe	8 m/s	40	2.4 MW	7,000MW/year	5,180 t

Table 4: Energy characteristics of the wind farms proposed in Minorca and Guadeloupe

Energy production from waste in Lanzarote and Galapagos

In Lanzarote, the Altener project also includes a study for the conversion of the Zonzamas landfill site (San Bartolomé, Lanzarote) into an environmental complex whose principal activity will be the production of energy from landfill biogas.

The project for building a centre for the biomethanisation and energy production from the organic waste generated in Lanzarote includes the creation of a module for sludge reception and mixing, a biomethanisation module, a cogeneration module, and a composting and refining centre.

The estimated total volume of waste to be treated is:

MSW 60,937 Tonnes/year
Wastewater treatment sludge: 6,002 Tonnes/year

Giving some 57,500 Tonnes/year for methanisation, generating 24 million kWh electrical energy per year.

In the Galapagos it is being developed a solid waste integral management project considering gasification and methanisation as possible energy recovery systems.

Photovoltaic electrification in the Galapagos

The electricity system on Floreana, one of the four populated islands in the

electrification of Floreana using a photovoltaic-wind power hybrid system.

Dissemination and exchange of experiences

Dissemination actions and the establishment of synergies with other projects and exchanges of experiences with other islands are important aspects of this project.

The dissemination of the projects set up and, above all, those executed, will be carried out in the most rapid and flexible way possible, seeking to harmonise and integrate the different initiatives and projects. To this end, a dossier has been designed and printed offering a graphic image of the project, describing its objectives and providing for gathering together of the information generated for its dissemination. The information produced includes computer files describing each project. Moreover, brochures will be published for each of the islands aimed at the hotel sector and for distribution amongst tourists. These will provide information about the hot water production projects carried out and about the "Biosphere Hotels: Quality for Life" certificate.

On another level, the information on projects will also be disseminated on the Internet, and co-operation between islands and at international level will be promoted, particularly as regards the fields of information, training and the exchange of experiences. Moreover, with a view to establishing synergies, consideration will be given to possible participation at forums and in other activities carried out under Altener projects developed on other islands.



