Renewable Energies in the Canary Islands: Present and Future

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Canary Islands Institute of Technology
(Instituto Tecnológico de Canarias – ITC)
ENERGY CONTEXT OF THE CANARIAN ARCHIPELAGO

Socioeconomic considerations

- Total population: 2 Millions (+ approx. 250,000 equiv. permanently living tourists = 12 Million per year!!)
- 7 islands with different dimensions and features (total area: 7,500 km²)
- Significant economic development in the last 15 years, GDP based on tertiary sector (tourism)

Energy

- Total external energy dependence
- Constant (significant) increase of energy demand
- Electricity generation based on fossil fuels (oil), relatively small power stations
- (5) insular electrical systems, very difficult to interconnect (volcanic origin of the islands)
- Low heating energy demand, decentralized heat production
ENERGY CONTEXT OF THE CANARIAN ARCHIPELAGO

- Recent entry in force of national legislation concerning insular and extrapeninsular electrical systems, and entry of the system operator (Red Eléctrica de España)
- Will to diversify energy sources (combined cycle power plants already installed, waiting for LNG introduction)
- Historical lack of water resources and big experience in the search of artificial water production systems (desalination market began in the 60’s) - Importance of the water-energy binomial
- Important weight of the transport sector

Renewable Energies

- Excellent potentials (particularly wind and sun), but still low contribution to the energy balance
- Still lack of information, at all levels, about energy saving technologies, demand management and RE
- Existence of qualified research groups and technology centres with know-how in this field
**CANARY ISLANDS ENERGY CONTEXT**

Structure of the internal market by fuel type

- **Gas-oil**: 30.78%
- **Kerosene**: 0.01%
- **Gasoline**: 17.05%
- **LPG**: 2.93%
- **Reffin. Gas**: 1.84%
- **Fuel-oil/Diesel-Oil**: 47.39%
- **Others**: 12.1%
- **Water + Electricity**: 2.4%
- **Automotion**: 29.9%
- **Others**: 12.1%

Structure of the internal market by sector
## Electricity generation technologies

### Primary energy sources

<table>
<thead>
<tr>
<th>Primary Energy Source</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oil products</td>
<td></td>
</tr>
<tr>
<td>Unelco-Endesa Thermal Power Stations</td>
<td>2,125</td>
</tr>
<tr>
<td>Other conven. Thermal Power Stations</td>
<td>25,900</td>
</tr>
<tr>
<td>Cogeneration</td>
<td>71,284</td>
</tr>
<tr>
<td>Renewable Sources</td>
<td></td>
</tr>
<tr>
<td>Wind</td>
<td>136,4</td>
</tr>
<tr>
<td>Minihydro</td>
<td>1,3</td>
</tr>
<tr>
<td>PV</td>
<td>0,4</td>
</tr>
</tbody>
</table>

### CANARY ISLANDS ENERGY CONTEXT

#### Technology

<table>
<thead>
<tr>
<th>Unelco Endesa</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Turbine</td>
<td>714,5</td>
</tr>
<tr>
<td>Diesel Motor</td>
<td>438,8</td>
</tr>
<tr>
<td>Gas Turbine</td>
<td>508,8</td>
</tr>
<tr>
<td>Combined Cycle</td>
<td>371,1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Power Stations</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Turbine</td>
<td>25,9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cogeneration</th>
<th>MW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steam Turbine</td>
<td>24,2</td>
</tr>
<tr>
<td>Diesel Motor</td>
<td>9,1</td>
</tr>
<tr>
<td>Gas Turbine</td>
<td>38,0</td>
</tr>
</tbody>
</table>

### (1) Only grid connected installations
<table>
<thead>
<tr>
<th>Island</th>
<th>Power (MW)</th>
<th>Energy (GWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CANARY TOTAL</td>
<td>2.116</td>
<td>8.223</td>
</tr>
<tr>
<td>GRAN CANARIA</td>
<td>905,3</td>
<td>3.391</td>
</tr>
<tr>
<td>FUERTEVENTURA</td>
<td>128,9</td>
<td>468</td>
</tr>
<tr>
<td>LANZAROTE</td>
<td>180,9</td>
<td>796</td>
</tr>
<tr>
<td>TENERIFE</td>
<td>795,8</td>
<td>3.249</td>
</tr>
<tr>
<td>LA PALMA</td>
<td>78,6</td>
<td>226</td>
</tr>
<tr>
<td>LA GOMERA</td>
<td>16,2</td>
<td>63</td>
</tr>
<tr>
<td>EL HIERRO</td>
<td>10,1</td>
<td>30</td>
</tr>
</tbody>
</table>
Contribution of the different sources and technologies to total production, by island
CANARY ISLANDS ENERGY CONTEXT

Total electrical production by origin

- Renewables
- Cogeneration and other thermal plants
- Unelco-Endesa Power Stations


Production (GWh)
### CANARY ISLANDS ENERGY CONTEXT

<table>
<thead>
<tr>
<th>YEAR</th>
<th>Gran Canaria</th>
<th>Tenerife</th>
<th>Lanzarote</th>
<th>Fuerteventura</th>
<th>La Palma</th>
<th>La Gomera</th>
<th>El Hierro</th>
<th>Total</th>
<th>Yearly increase</th>
</tr>
</thead>
<tbody>
<tr>
<td>1985</td>
<td>1139.5</td>
<td>945.4</td>
<td>64.2</td>
<td>154.2</td>
<td>83.4</td>
<td>13.6</td>
<td>6.7</td>
<td>2407.0</td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>1739.0</td>
<td>1470.5</td>
<td>318.9</td>
<td>149.9</td>
<td>111.1</td>
<td>23.6</td>
<td>11.3</td>
<td>3824.2</td>
<td></td>
</tr>
<tr>
<td>1995</td>
<td>2237.6</td>
<td>1937.7</td>
<td>407.7</td>
<td>242.7</td>
<td>157.4</td>
<td>35.0</td>
<td>17.2</td>
<td>5035.4</td>
<td></td>
</tr>
<tr>
<td>1996</td>
<td>2328.5</td>
<td>2039.0</td>
<td>426.6</td>
<td>274.3</td>
<td>154.6</td>
<td>35.4</td>
<td>18.1</td>
<td>5276.6</td>
<td>4.79%</td>
</tr>
<tr>
<td>1997</td>
<td>2490.6</td>
<td>2179.4</td>
<td>469.2</td>
<td>289.0</td>
<td>166.0</td>
<td>38.1</td>
<td>20.0</td>
<td>5652.4</td>
<td>7.12%</td>
</tr>
<tr>
<td>1998</td>
<td>2618.1</td>
<td>2329.7</td>
<td>509.2</td>
<td>310.7</td>
<td>181.4</td>
<td>42.4</td>
<td>21.9</td>
<td>6013.4</td>
<td>6.39%</td>
</tr>
<tr>
<td>1999</td>
<td>2778.3</td>
<td>2492.0</td>
<td>566.1</td>
<td>327.3</td>
<td>193.6</td>
<td>46.2</td>
<td>23.2</td>
<td>6426.8</td>
<td>6.87%</td>
</tr>
<tr>
<td>2000</td>
<td>2959.0</td>
<td>2666.4</td>
<td>617.7</td>
<td>357.0</td>
<td>209.1</td>
<td>48.7</td>
<td>23.4</td>
<td>6881.3</td>
<td>7.07%</td>
</tr>
<tr>
<td>2001</td>
<td>3131.8</td>
<td>2860.5</td>
<td>628.1</td>
<td>438.4</td>
<td>206.7</td>
<td>52.4</td>
<td>26.6</td>
<td>7344.6</td>
<td>6.73%</td>
</tr>
<tr>
<td>2002</td>
<td>3223.1</td>
<td>3006.0</td>
<td>718.8</td>
<td>444.5</td>
<td>208.1</td>
<td>56.2</td>
<td>27.8</td>
<td>7684.3</td>
<td>4.63%</td>
</tr>
<tr>
<td>2003</td>
<td>3391.2</td>
<td>3249.3</td>
<td>795.8</td>
<td>467.7</td>
<td>227.3</td>
<td>63.5</td>
<td>30.0</td>
<td>8224.9</td>
<td>7.03%</td>
</tr>
</tbody>
</table>

#### Evolution of yearly electrical energy production, by island (GWh)

![Graph of yearly electrical energy production](image)

#### Evolution of installed electrical power

![Graph of installed electrical power](image)
GHG-Emissions increase in the Spanish Regions 1990-2002
CO2 Emissions trend of the current model

Kyoto threshold
Canary Islands

+75%
+30%
Expected evolution of CO2 Emissions with the new framework
Energy Plan of the Canary Islands (PECAN 2006)

Motivation

Changes in the energy sector:
- Liberalization of electrical and hydrocarbon sectors
- Development of RE technologies
- Introduction of new electricity generation technologies: combined cycles
- Increasing concern about quality and guarantee of energy supply

Increasing environmental concern:
- Need to promote energy efficiency and saving
- Commitment to Kyoto Protocol
- Minimization of environmental effects of energy and energy installations
PECAN 2006

**PRINCIPLES**

1. To guarantee energy supply
2. To reduce energy consumption and its environmental impact
3. To promote RE use

**OBJECTIVES**

- Improvement of storage security
- Improvement of service quality
- Competitive energy prices
- Reduction of CO2 Emissions
- Reduction of energy intensity
- Promotion of energy saving and cogeneration
- Reduction of the environmental impact of energy installations
- Increase in the contribution of Renewable Energies
Objectives related to energy saving, environmental protection and RE promotion

- **Reduction of CO2 emissions**
  - Introduction of natural gas in order to partially replace oil use
  - The necessary installations will be available in 2007 for Gran Canaria and in 2009 for Tenerife

- **Reduction energy intensity and promotion of energy saving and cogeneration**
  - Dissemination campaigns and actions aimed at reducing energy consumption in public buildings, transport, housings and public lighting
  - Incentives to cogeneration by means of a stability guarantee of the fuel purchase price

- **Increase of RE contribution**
  - Measures in order to achieve 800 MW wind power in 2012
  - Flexible financing program for solar thermal systems (275,000 m² in 2012)
  - Program for promotion of Solar PV in public buildings of the Canary Islands Regional Government (1 MWp/year in the short term)
LEGAL FRAMEWORK - ENERGY PLANNING

ENERGY EFFICIENCY AND SAVING, DEMAND MANAGEMENT

- Creation of the Canarian Energy Agency
- Elaboration of Energy Atlas
- Energy Efficiency and Saving Plan
- Promotion of low consumption electric appliances and water saving devices
- Energy audits
- Bioclimatic construction
- Promotion of collective transport
Two plants for reception, storage and regasification of LNG:
- Gran Canaria → Polígono Industrial de Arinaga
- Tenerife → Polígono Industrial de Granadilla

Gas pipes for gas transport from the plants to the power stations

Capacity for gas ships up to 150,000 m³.
### CARACTERISTICAS DE LAS PLANTAS DE GNL

<table>
<thead>
<tr>
<th>Característica</th>
<th>Detalles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacidad Barcos Metaneros</td>
<td>145,000 m³ - 61,000 Ton</td>
</tr>
<tr>
<td>Capacidad de Almacenamiento Fase I</td>
<td>150,000 m³</td>
</tr>
<tr>
<td>Capacidad de Gasificación Nominal</td>
<td>250,000 Nm³/h</td>
</tr>
</tbody>
</table>

**Ciclo combinado de Gran Canaria**
INTRODUCCIÓN DE LNG

VAPORIZADORES

TANQUE DE ALMACENAMIENTO

METANERO Y BRAZOS DE DESCARGA
INTRODUCTION OF LNG

- Depósito
- Compresor
- Relicuador
- Vaporizadores
- Bombas de alta presión
- Suministro a 46 bar
ENORMOUS POTENTIALS

Solar Energy
- Sun hours: 2500 - 3000 h/año
- Radiation: 5 - 6 kWh/m² día

Wind Energy
- Average wind speeds: 7 – 8 m/s (trade winds, constant character)
- Production: 3.000 – 4.500 (!!) equivalent hours
R&D in Renewable Energies
- Production of electricity, hydrogen, heat and cold
- Water desalination (using RE)

POZO IZQUIERDO (Gran Canaria)
Pozo Izquierdo Facilities

Annual mean wind speed: 7.8 m/s (10 m.a.s.l)
Solar irradiation on an horiz. Surface: 5.7 kWh/m² day
Annual mean temperature: 23.5 °C
Annual mean humidity: 65-70 %
Annual rain fall: 105 mm (5-10 rainy days/year)
Renewable Energies & Water Technologies

R & D Lines (I)

- Electricity production by renewable energy sources
- Fresh Water production (water desalination) using renewable energy systems
- Cold and ice production using renewable energy systems
- Application of renewable energy systems in buildings and agriculture
- Development of small to medium size wind energy systems (incl. wind-diesel)
Renewable Energies & Water Technologies

R & D Lines (II)

- Testing of solar thermal collectors and systems
- Penetration of renewable energy systems in weak electrical grids
- Development and evaluation of (non conventional) desalination and water treatment systems
- Production of hydrogen by renewable energy systems
- Sustainable energy and water management
Drinking water supply with stand alone systems

CONTEDES - Water desalination container (stand alone, grid connection not necessary)
DESSOL - Reverse osmosis desalination plant driven by a stand alone photovoltaic system
DESALPARQ - Modular reverse osmosis desalination plant driven by an off-grid wind farm
AEROGEDESA - Sea water desalination plant directly driven by a wind turbine

Electricity supply to isolated areas

MORENA - Container with hybrid system (wind-photovoltaic-diesel) for electricity supply in small rural villages
SISTEMAS HÍBRIDOS - Hybrid systems for electricity supply (wind-photovoltaic-diesel) to isolated villages
**Ice and cold supply with stand alone systems**

AEROFRIGO - Cold-storage plant driven by a small wind turbine  
AEROHIELO - Modular ice maker driven by a small wind turbine  
FOTOHIELO - Ice maker driven by a stand alone solar photovoltaic system

**Integrated systems for electrical energy, water, cold and ice supply in isolated areas**

PUNTA JANDIA – Wind –diesel system for the production of electricity, water, cold and ice in remote villages  
MORENA CONTEDES - Hybrid system (wind-photovoltaic-diesel) easily transportable in container for the supply of electrical energy, water, cold and ice
Wind-Diesel system for electricity, water, cold and ice supply in Punta Jandía (Fuerteventura)
SDAWES

RO desalination plant powered by an off-grid wind farm
### Installed power (2004): 136 MW

*Produced Energy (2004): 330 GWh*

<table>
<thead>
<tr>
<th>Island</th>
<th>Power (kW)</th>
<th>Energy (MWh)</th>
<th>% penetration</th>
</tr>
</thead>
<tbody>
<tr>
<td>LANZAROTE</td>
<td>6.405</td>
<td>13.448</td>
<td>1.7%</td>
</tr>
<tr>
<td>TENERIFE</td>
<td>30.730</td>
<td>62.657</td>
<td>4.9%</td>
</tr>
<tr>
<td>GRAN CANARIA</td>
<td>75.045</td>
<td>227.983</td>
<td>6.7%</td>
</tr>
<tr>
<td>LA PALMA</td>
<td>5.580</td>
<td>11.145</td>
<td>4.9%</td>
</tr>
<tr>
<td>LA GOMERA</td>
<td>360</td>
<td>252</td>
<td>1.1%</td>
</tr>
<tr>
<td>EL HIERRO</td>
<td>100</td>
<td>334</td>
<td>0.4%</td>
</tr>
<tr>
<td>FUERTEVENTURA</td>
<td>11.610</td>
<td>26.341</td>
<td>5.6%</td>
</tr>
</tbody>
</table>

*: Wind energy penetration in relation to electrical energy produced

Installed power (2004): 136 MW

Produced Energy (2004): 330 GWh

LANZAROTE
- Power (kW): 6.405
- Energy (MWh): 13.448
- % penetration: 1.7%

TENERIFE
- Power (kW): 30.730
- Energy (MWh): 62.657
- % penetration: 4.9%

GRAN CANARIA
- Power (kW): 75.045
- Energy (MWh): 227.983
- % penetration: 6.7%

LA PALMA
- Power (kW): 5.580
- Energy (MWh): 11.145
- % penetration: 4.9%

LA GOMERA
- Power (kW): 360
- Energy (MWh): 252
- % penetration: 1.1%

EL HIERRO
- Power (kW): 100
- Energy (MWh): 334
- % penetration: 0.4%

FUERTEVENTURA
- Power (kW): 11.610
- Energy (MWh): 26.341
- % penetration: 5.6%
WIND ENERGY

Evolution of installed power

Evolution of produced energy
Evolution of produced energy in 2004

Gran Canaria wind farms

Equivalent hours in 2004
Barriers
- Availability of space (approx. 45% of the Canarian territory is protected)
- Grid penetration is limited due to weak character of the insular electrical networks

Measures for further deployment
- R&D focused on maximising grid penetration (prediction, dynamic grid studies, adaptation of technologies to weak grids, etc.) and development of stand-alone systems
- Management of wind resources
- Regional legislation
  - Technical-administrative conditions
  - Tenders:
    - Repowering
    - Wind power dedicated to specific consumers (industries, desalination plants, etc)
    - Wind power for R&D activities
20% of the energy production is dedicated to: Desalination, and pumping (wells, elevation to consumption points).

**Uses of desalinated water:**

<table>
<thead>
<tr>
<th>Uses</th>
<th>Production</th>
<th>Plants</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban &amp; Touristic</td>
<td>374,000 m³/d</td>
<td>153</td>
</tr>
<tr>
<td>Irrigation</td>
<td>146,000 m³/d</td>
<td>100</td>
</tr>
</tbody>
</table>

1 kg of fuel is needed to desalinate 1 m³ of seawater

For 522,000 m³/d (current desalination capacity in the Canary Islands) this is equivalent to import 150,000 Tons of fuel per year
AGRAGUA – Parque Eólico Montaña Pelada (Gáldar)

- 15.000 m³/d
- 4.62 MW
- 5.1 kWh/m³ (extracción + desalación + bombeo)

<table>
<thead>
<tr>
<th>FECHAS</th>
<th>PRODUCCIÓN (m³)</th>
<th>CONSUMOS (kWh)</th>
<th>PRODUCCIÓN PARQUE EOLICO (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4° trim- 1998</td>
<td>1.221.355</td>
<td>6.128.080</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>1999</td>
<td>4.763.621</td>
<td>24.959.620</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>2000</td>
<td>4.979.812</td>
<td>25.708.620</td>
<td>-----------------------------</td>
</tr>
<tr>
<td>2001</td>
<td>4.910.820</td>
<td>15.987.179</td>
<td>10.275.528</td>
</tr>
<tr>
<td>2004</td>
<td>3.615.784</td>
<td>10.289.804</td>
<td>8.656.732</td>
</tr>
</tbody>
</table>
SOSLAires CANARIAS S.L. – Vargas (Gran Canaria)

- Autoconsumo de la planta 2003: 1.547.244 kWh
- Consumo planta de red 2003: 681.101 kWh
- Total consumo 2003: 2.228.345 kWh

- 5.000 m³/d
- 2.64 MW
SOSLAIRES CANARIAS S.L. – Vargas (Gran Canaria)

- Tarifa Energía de red: Agrícola R.1.
- Precio medio año 2003: Aprox. 6,85 cent€ /kWh
- Precio venta agua desalada: 60 cent€ /m3
- Precio medio venta electricidad (2003): 7 cent€ /kWh

<table>
<thead>
<tr>
<th>PRODUCCIÓN</th>
<th>CONSUMO ALIMENTACIÓN</th>
<th>CONSUMO PROCESO</th>
<th>CONSUMO ELEVACIÓN</th>
<th>CONSUMOS AUXILIARES Y ASOCIADOS</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>5000 m³/d</td>
<td>0,4 kWh/m³</td>
<td>1,9 kWh/m³</td>
<td>0,3 kWh/m³</td>
<td>0,2 kWh/m³</td>
<td>2,8 kWh/m³</td>
</tr>
</tbody>
</table>

Variadores de frecuencia en todos los procesos, salvo elevación.
<table>
<thead>
<tr>
<th>Island</th>
<th>Solar thermal (m²)</th>
<th>Solar PV (kWp)</th>
</tr>
</thead>
<tbody>
<tr>
<td>LA PALMA</td>
<td>1.889</td>
<td>60</td>
</tr>
<tr>
<td>TENERIFE</td>
<td>24.377</td>
<td>136</td>
</tr>
<tr>
<td>GRAN CANARIA</td>
<td>19.031</td>
<td>223</td>
</tr>
<tr>
<td>LA GOMERA</td>
<td>1.182</td>
<td>11</td>
</tr>
<tr>
<td>EL HIERRO</td>
<td>325</td>
<td>12</td>
</tr>
<tr>
<td>FUERTEVENTURA</td>
<td>1.428</td>
<td>34</td>
</tr>
<tr>
<td>LANZAROTE</td>
<td>4.598</td>
<td>95</td>
</tr>
</tbody>
</table>
- Aprox. 70,000 m² installed
- Goal (2012): 275,000 m² (?)
- ITC has accredited solar collector testing lab (first one in Spain, adscribed to European Solar Keymark label)
- Enormous potential in the touristic sector
- Regional Government promotion program PROCASOL, managed by ITC
- Installed power: Aprox. 600 kWp (stand-alone systems) and 400 kWp (grid-connected systems)
- Production: 1300 – 1700 hours
- Goal: ??????

Evolution of produced energy in 2004
(total: 227 MWh)

Equivalent hours in 2004
Energy Saving, Bioclimatic projects
- Bioclimatic project in 355 VPO
- Energy audits

Mini-hydro
- Installed power: 1.263 MW (2 plants), production 2004: 2.846 MWh
- Possible increase of installed power up to 7 MW
- El Hierro project

Other Renewables
- Biomass exploitation possibilities: biogas from waste, WWTP sludge, biodiesel (very small scale)
- Geothermal potential still to explore
- Interesting wave potential (2000 equiv. Hours in northern areas, 40-80 MW?)
- R&D in sustainable hydrogen production technologies
ITC cooperation projects in the Northwest African Coast (Morocco, Mauritania, Senegal, Cape Verde, Tunisia)

- Elaboration of a feasibility study for the electrification and water supply (using renewable energy systems) of 32 villages in the province of Essaouira (Morocco) (finished 2000)
- Installation of a MORENA unit (hybrid PV-wind-diesel system) for the electrification of common areas of the village Ouassen (province of Essaouira, Morocco) (in operation since 2001)

- Active participation in the Energy and Water Seminar organised by CDER/Resing in Marrakech (April 2002)

- Organisation of the 1-week Seminar “Desalination and Renewable Energies”, held at ITC (July 2003), with attendance of researchers/scientists/personnel from energy and water bodies coming from Mauritania, Morocco, Algeria, Egypt, Jordan, Palestinian Territories, etc.

- Total electrification of the village Talate Ourgane (Morocco), including water pumping and ice production demonstration system (on-going)
- Elaboration of the wind atlas of Northern Mauritania (2000)
- Creation of the Thematic Parc “Canary Islands” on Renewable Energies, Desalination and Drip Irrigation at the Faculty of Sciences and Technology of the University of Nouakchott, Mauritania (including maintenance, training activities; on-going)

- Installation 4 RO desalination plants (20-40 m³/d) at the National Parc Banc d’Arguin (Mauritania) (sent by the Canary Islands’ Government through ITC; finished)
Supply of the 4 Mauritania RO plants with Renewable Energies (starting)

Participation in EC SMADES and ADU-RES projects (on-going)

Technical assistance to Spanish PV company ISOFOTON: feasibility of supplying 15 small RO sea- and brackish water desalination plants with PV in Senegal (finished)

Elaboration of a Plan for the Promotion of Energy Efficiency and Renewable Energies in Morocco (finished)

Brackish water desalination plant powered by a PV system in Ksar Ghilène (Tunisia) (on-going)
Hydrogen (produced by RE) could represent a promising energy storage solution for islands.

Islands could be excellent showcases for the introduction of the hydrogen economy.
OUTSTANDING PROJECTS

RES2H2 (EC FP5)

Design and installation, at ITC Pozo Izquierdo premises, of a wind-hydrogen integrated system for the controlled production of electricity and water.

HYDROHYBRID (ITC project)

Small scale hydrogen production driven by a hybrid wind-PV system (installation on-going).
El Hierro Wind-Hydro Power Station (partially EC funded)
Thank you very much

Gonzalo Piernavieja
ITC