Pact of Islands European Conference
Brussels, 21 November 2012

Fostering Innovative Renewable Energy Projects through PPP: El Hierro, La Graciosa and other island initiatives

Canary Islands Institute of Technology (ITC)

Gonzalo Piernavieja
Director

EUROPEAN ISLANDS OFFER CHALLENGES TO THE EC

The small and weak island grids limit the penetration of variable and intermittent RES.

Most islands have achieved their maximum level of RES penetration that their electrical systems can support without risking grid stability, which makes it difficult for private investors to install new wind and solar systems.
New infrastructure for massive energy storage and R&D in new energy vectors is needed to guarantee that new RES systems do not affect the stability of the islands electrical systems, and European financial support is a key issue.

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

Needed EC support for overcoming existing barriers to maximum penetration of RES in European Islands

Existing barriers to RES include technical, regulatory/administrative, marketing, but European support should focus in existing financial barriers to private investment in RES projects

- **High cost of the technologies**
- **High upfront payment and relative long payback periods**
- **High financing costs**

The EC could contribute to RES projects in European island regions through

- **Favourable loans**
- **Capital subsidies**
- **Tariff support schemes**

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

Bankable Projects

SUSTAINABLE ENERGY EUROPE

EUROPEAN COMMISSION

BANKABLE PROJECTS

Identify and analyse potential Renewable Energies, Energy Efficiency and Sustainable Transport feasible projects, to foster private investment with public support (public-private partnership)

- **Identification of Projects**

A preliminary list of 92 identified projects has been compiled for the 11 participating European island regions

- **Prioritisation of key projects to achieve targets**

A second list of 54 projects chosen for bankability analysis

- **Pre-feasibility studies & screening for bankability**

Analysis of the projects to estimate their profitability in terms of financial parameters (PAYBACK, NPV and IRR)

- **Positive externalities identified and valued for each proposed project**
- **Assessment for public supports, through possible capital grants needed to assure a minimum reasonable profitability for private investors in each project proposal**

INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EUROPEAN COMMISSION

IDENTIFYING POTENTIAL BANKABLE PROJECTS

Projects that will contribute to increase RES penetration in European Islands in all the energy value chain

Generation → **Wind, solar, Wave, Geothermal, Biomass, hybrid (wind-diesel)**

Energy Storage → **Reversible pump-hydro**
Batteries
Hydrogen

Distribution → **Microgrids, district heating and cooling, etc.**

Energy Efficiency

- → **Primary sectors**
  Industry
  Services
  Residential

Final consumption → **Manageable loads: e.g. electric vehicles, Water desalination**

SUSTAINABLE ENERGY EUROPE

INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EUROPEAN COMMISSION

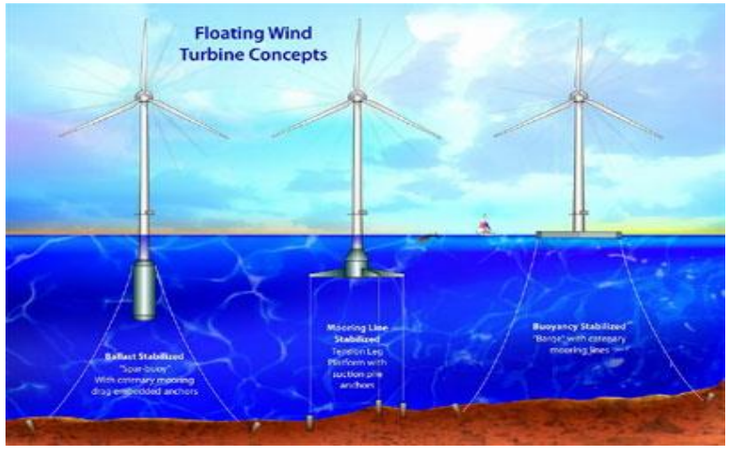
ALL PARTNERS – Identification of projects

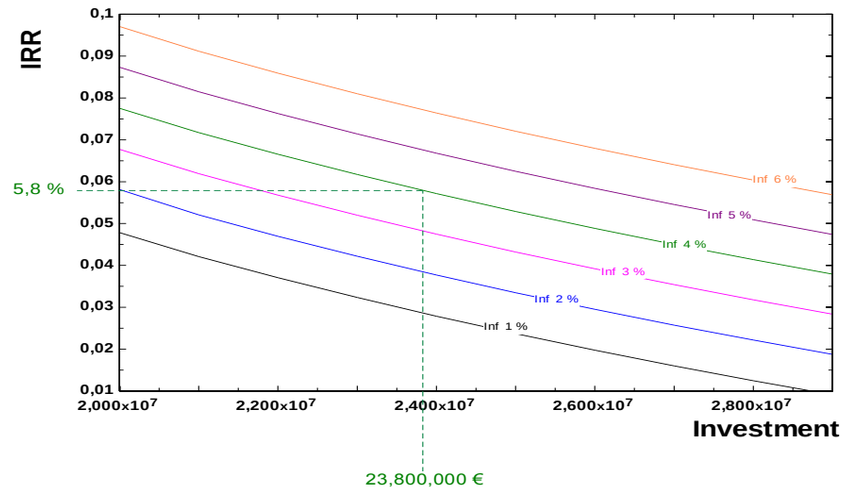
Partners	Number of Identified Projects	Number of analysed projects
Co - WESTERN ISLES	3	3
P1 – MUN. OF GOTLAND	3 + 3*	3
P2 - AREAM	5	2
P3 – ITC (WP Leader)	7	7
P5 - DAFNI	24	11
P6- REAC	22	7
P7 - PEPS	6	6
P8 - MALTA	6	6
P9 - CYPRUS EN. AG.	6	3
P10 - SAMSØ EN. ACAD.	4	2
P11 - ARENA	4	2
TOTAL	**92**	**54**

* Olands

** Saaremaa

*** Hiumaa





INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EUROPEAN COMMISSION

BANKABILITY INDEX

This index is an indicator that expresses the percentage of public support that each project needs to achieve bankability (produce a positive return on investment for the private investor).

This Bankability indicator has been defined from 0 to 10 in order to provide a parameter that allows creating a scale of "dependence on public funding" among different project.

NEEDED PUBLIC SUPPORT	BANKABILITY INDEX
0% - 10%	0
11% - 20%	1
21% - 30%	2
31% - 40%	3
41% - 50%	4
51% - 60%	5
61% - 70%	6
71% - 80%	7
81% - 90%	8
91% - 99%	9
100%	10

Bankability indicator=0 : project needing less that 10 % (in terms of investment cost) of public subsidies.

Bankability indicator=10 : project investment completely financed with public subsidies.

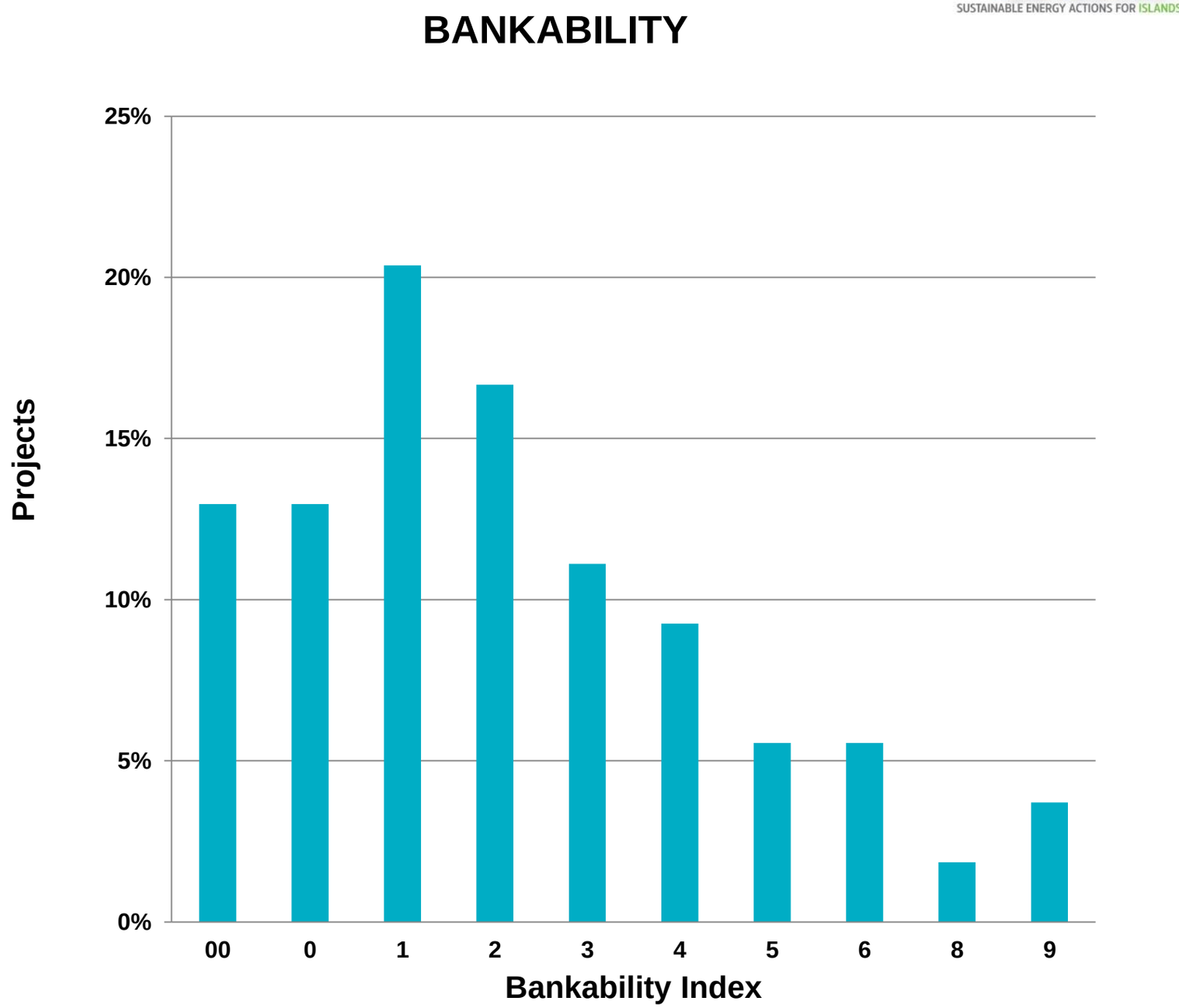
INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EUROPEAN COMMISSION

RESULTS OF BANKABILITY ANALYSIS

BANKABILITY INDEX	No. of PROJECTS	
00*	6	13%
0	8	13%
1	11	20%
2	9	17%
3	6	11%
4	5	9%
5	3	6%
6	3	6%
8	1	2%
9	2	4%
TOTAL	54	100%



* Bankable by themselves without any need of public support

SUSTAINABLE ENERGY EUROPE

EUROPEAN COMMISSION

LA GRACIOSA

(an ISLE-PACT project)

SUSTAINABLE ENERGY ACTIONS FOR ISLANDS

SUSTAINABLE ENERGY EUROPE

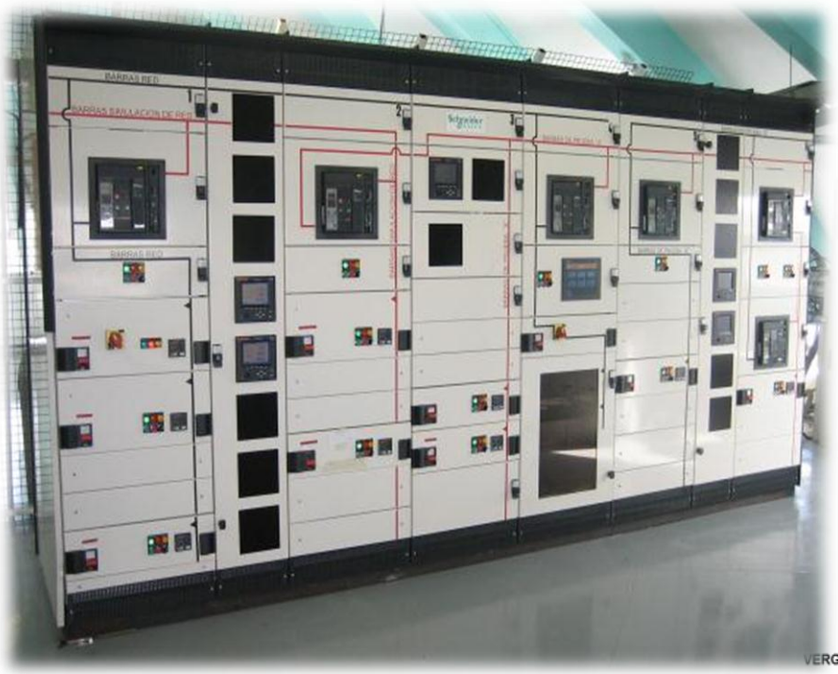
INSTITUTO TECNOLÓGICO DE CANARIAS

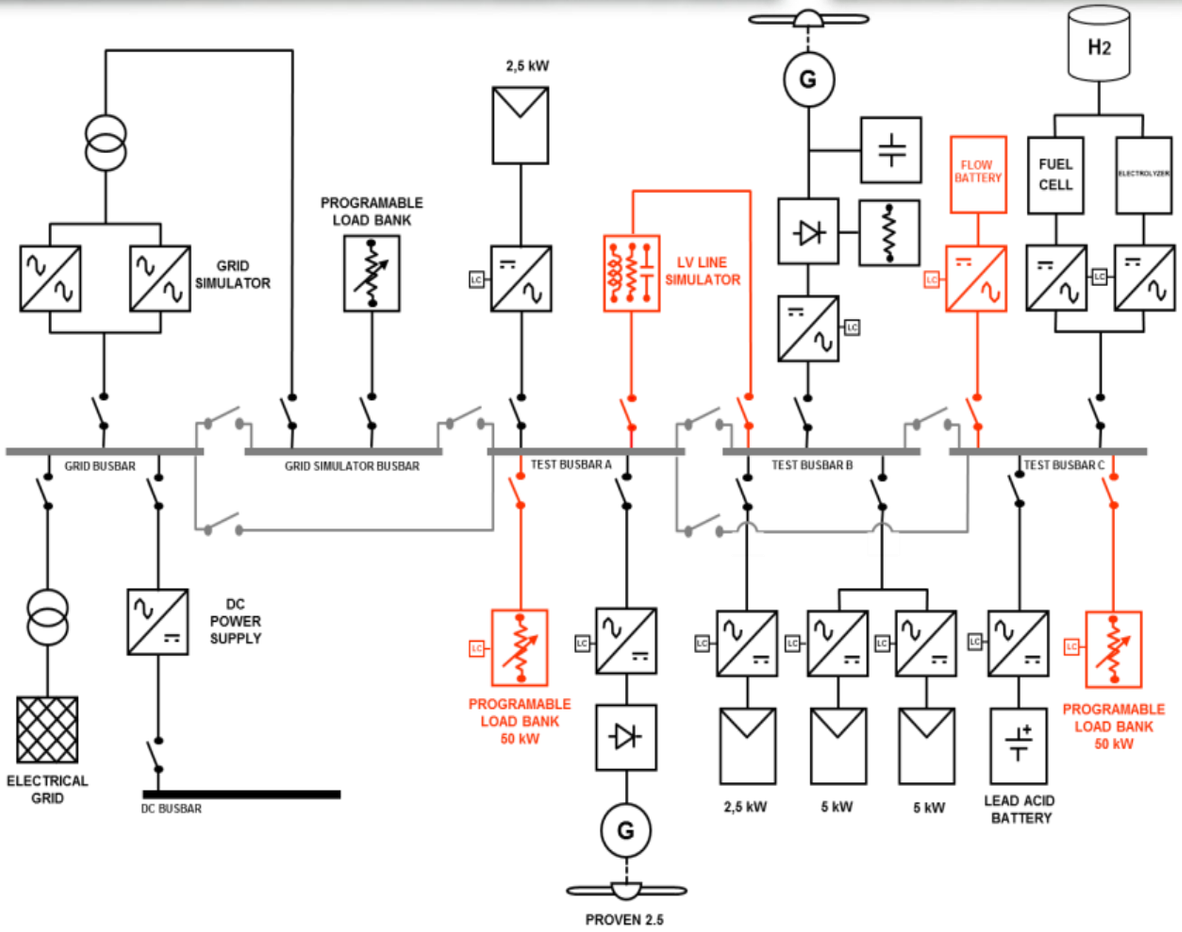
Gobierno de Canarias

EUROPEAN COMMISSION

ITC activity in MICROGRIDS

Distributed Generation Laboratory



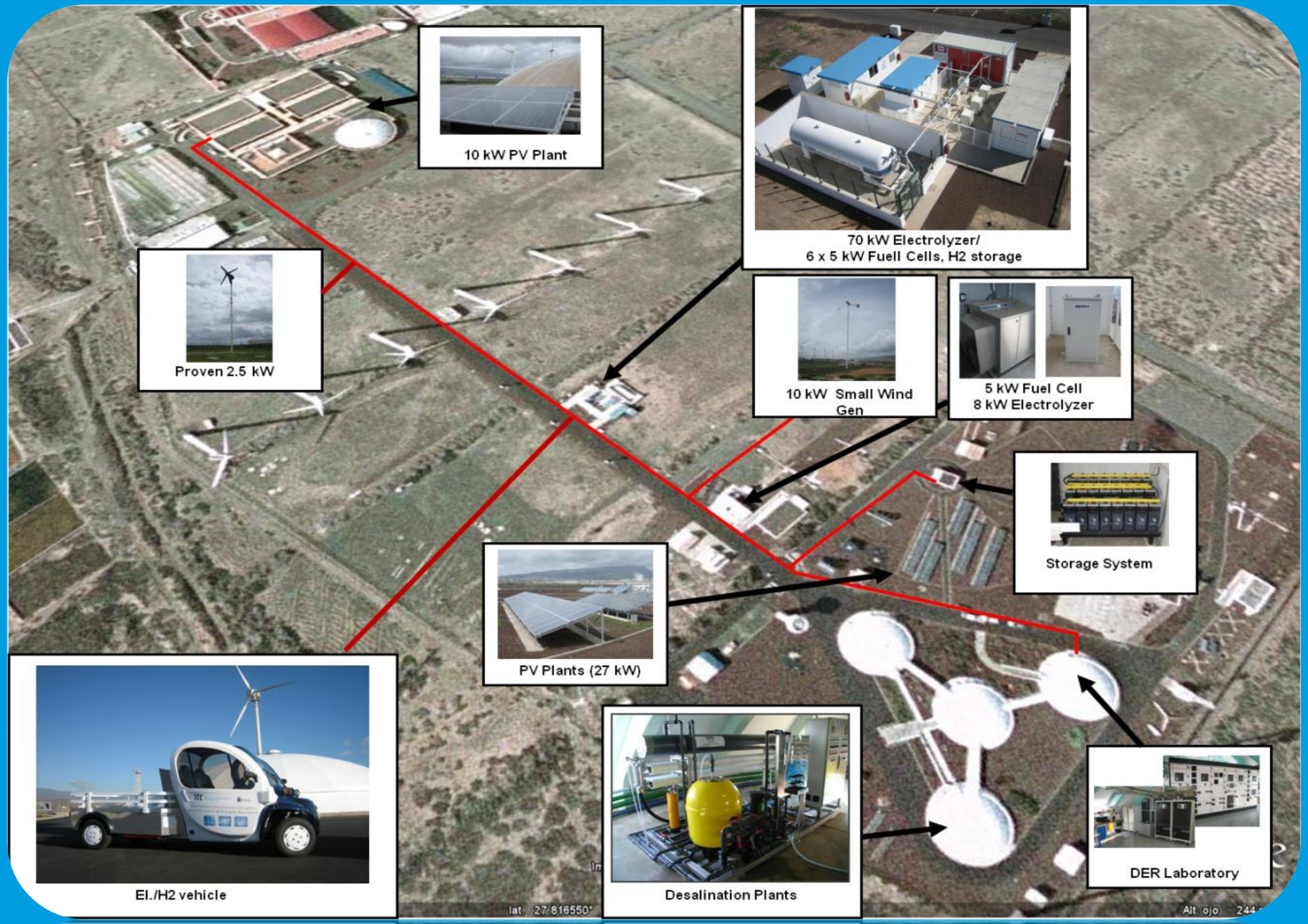


- **PV: 27 kWp**
- **Wind: 7,5 kW**
- **Programmable resistive and inductive loads**
- **Storage systems (300 kWh)**
- **Electrolyser 70 kW**
- **Fuel cells 6 x 5 kW**
- **Grid simulator 125 kVA**
- **Grid analysers and other measuring equip.**

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

ITC – Pozo Izquierdo RES MICRO-GRID



La Graciosa 100% RES

La Graciosa:
650 inhabitants
0.7 MW peak
2 GWh/y demand

Smart Microgrid with high RES penetration, energy storage (incl. desalination) and electric vehicles fleet

INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

Microgrid for La Graciosa

658 permanent residents
342 houses

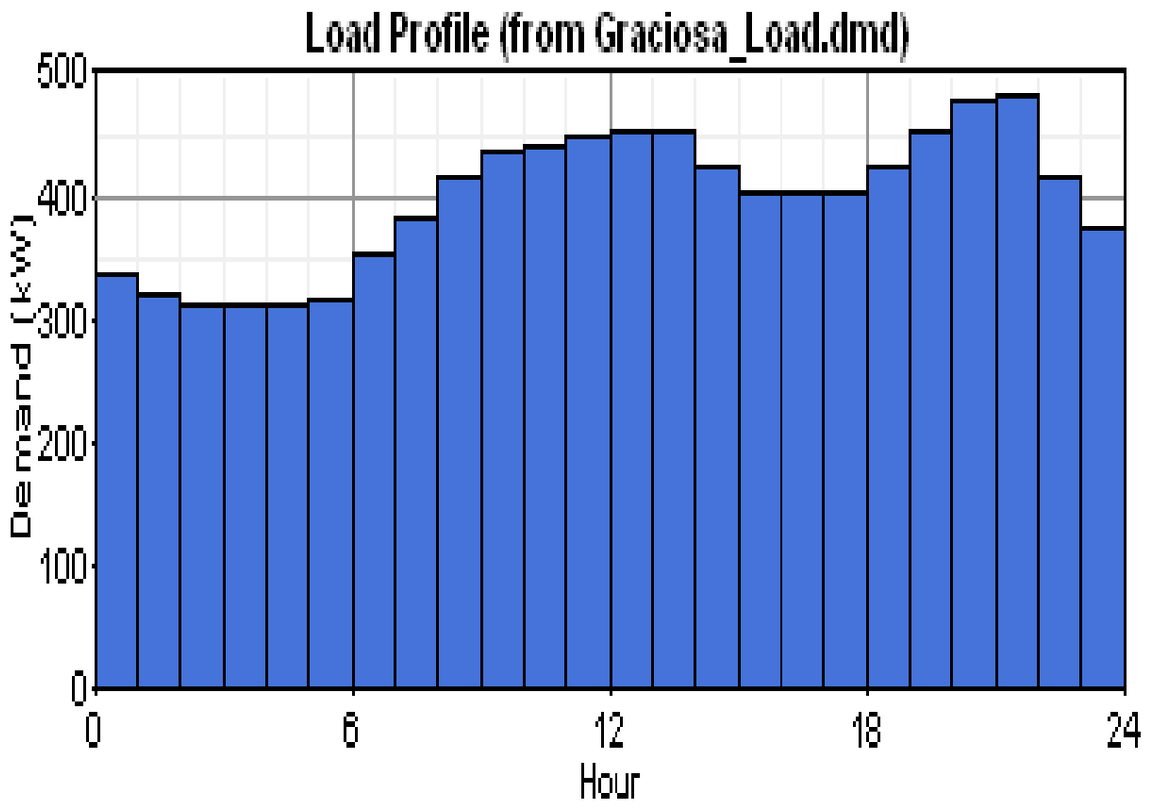
Objectives

Minimizing the needs for fossil fuels to satisfy the electricity demands from households, productive activities and public services, by maximizing the penetration of RES.

Electrric Loads

Currently there is a submarine cable connection with power capacity of 1,030 kW, and a yearly electric consumption of 3.484.914 kWh.

Minimum power	**204,08 kW**
Maximum power	**668,00 kW**



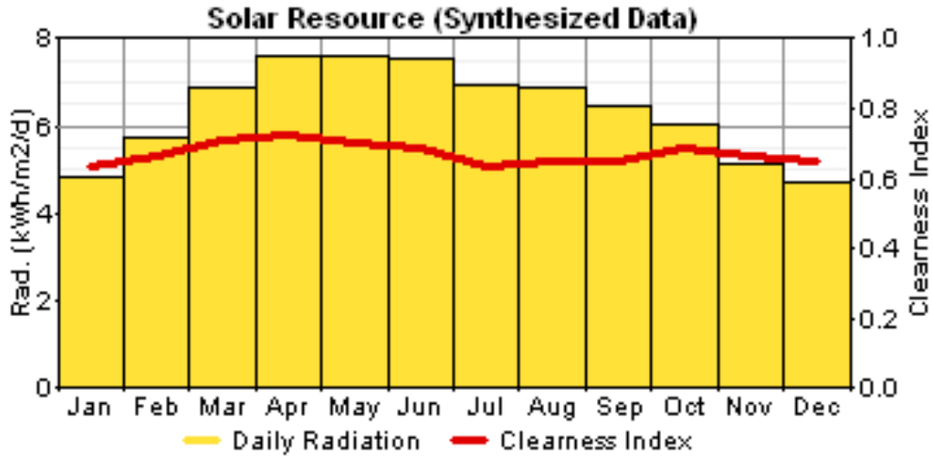
Hr	Power
1	337.9 kW
2	320.1 kW
3	313.5 kW
4	310.2 kW
5	310.5 kW
6	314.7 kW
7	351.5 kW
8	381.5 kW
9	413.9 kW
10	434.1 kW
11	441.3 kW
12	448.0 kW
13	454.4 kW
14	453.6 kW
15	424.4 kW
16	403.3 kW
17	404.8 kW
18	404.4 kW
19	424.8 kW
20	453.8 kW
21	478.3 kW
22	479.5 kW
23	415.4 kW
24	373.9 kW

La Graciosa

Latitud:	29’ 13 ‘’ North
Longitud:	13’ 30’’ West

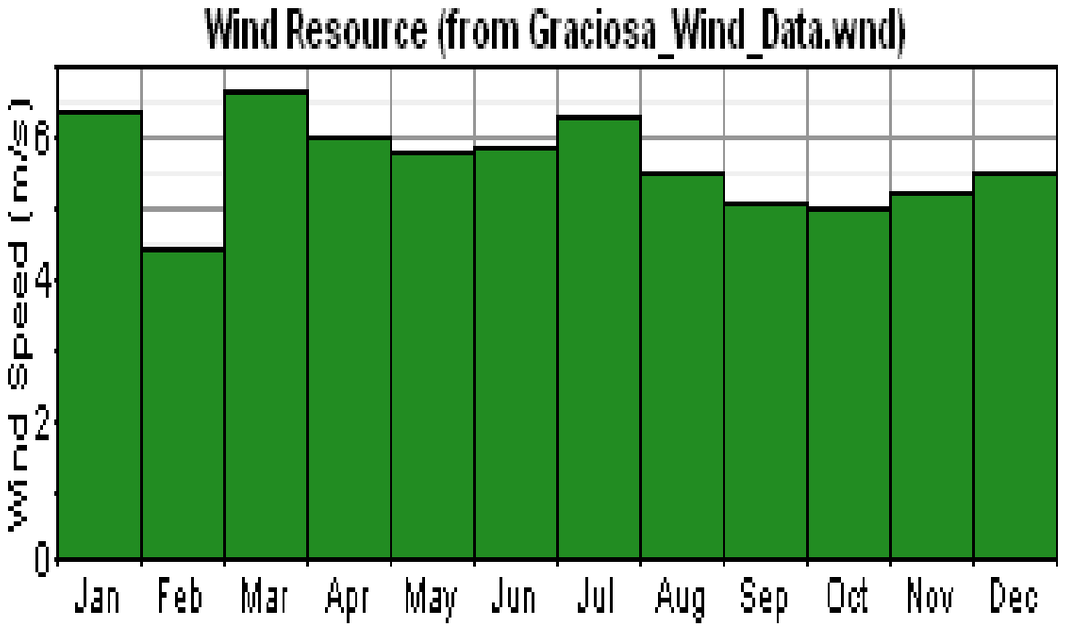
	Average wind speed
	m/s
Jan	6.4
Feb	4.4
Mar	6.7
Apr	6.0
May	5.8
Jun	5.9
Jul	6.3
Ago	5.5
Sep	5.1
Oct	5.0
Nov	5.3
Dic	5.5
Annual av.	5.7

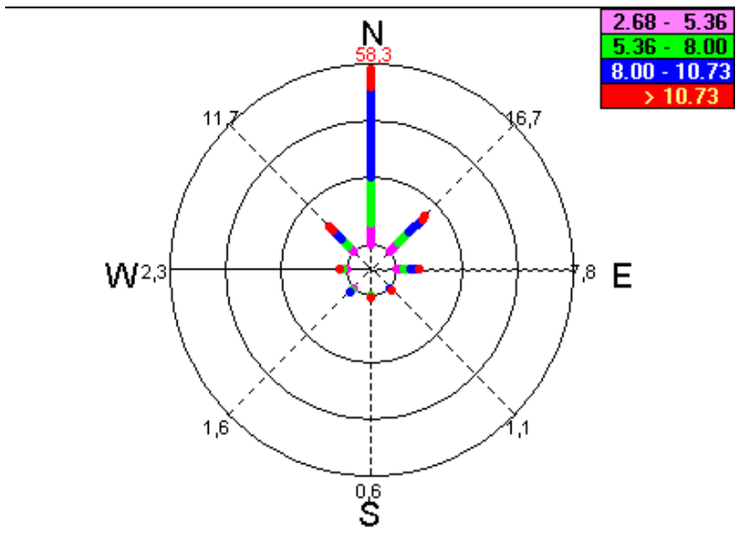
Solar resources



	Average radiation
	kWh/m2/day
Jan	3.2
Feb	3.7
Mar	4.6
Apr	5.3
May	5.9
Jun	6.1
Jul	6.6
Ago	6.2
Sep	5.8
Oct	4.3
Nov	3.4
Dic	3.0
	4.9

Wind resources

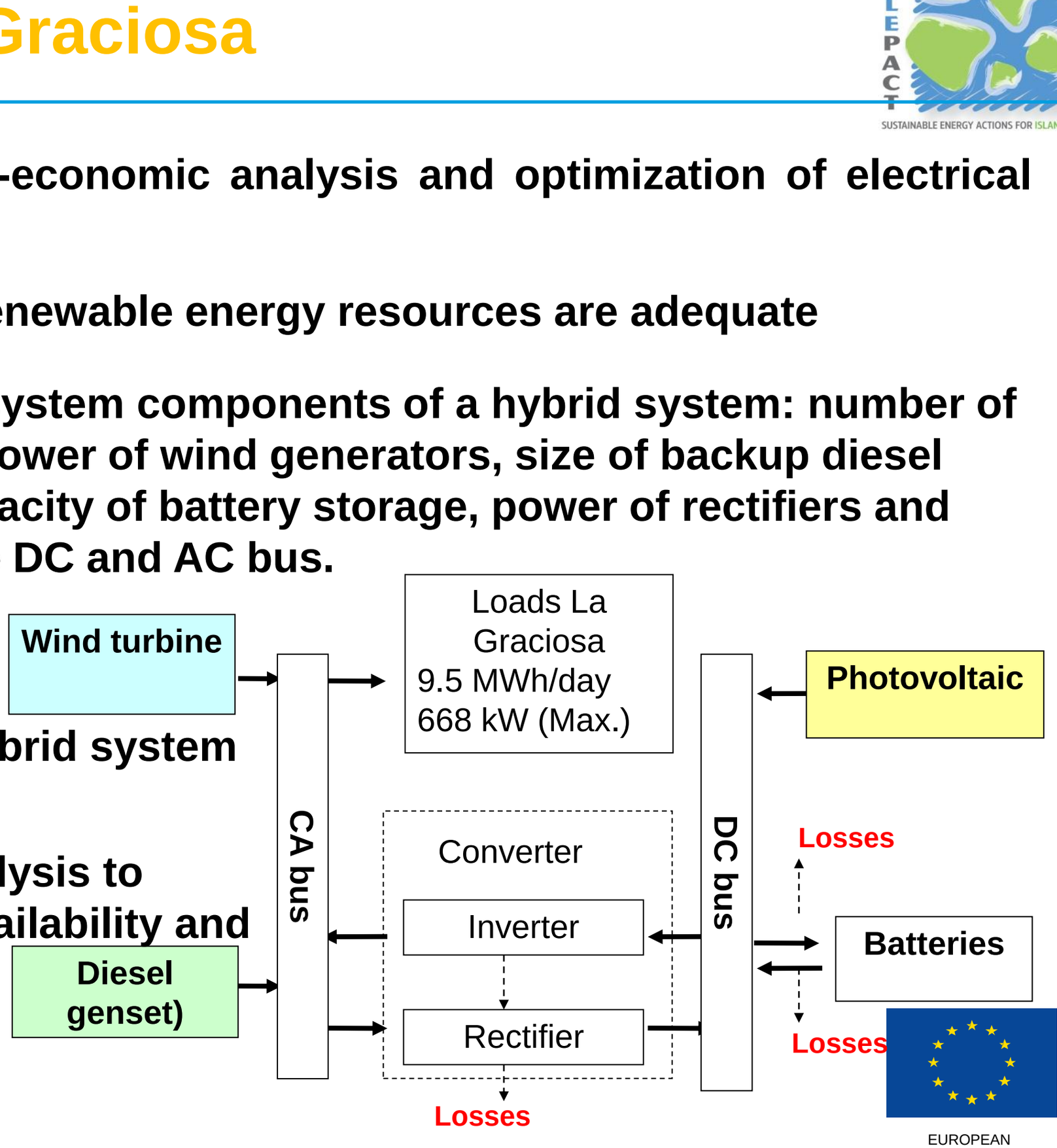




Microgrid for La Graciosa

Software used for techno-economic analysis and optimization of electrical microgrid for La Graciosa.

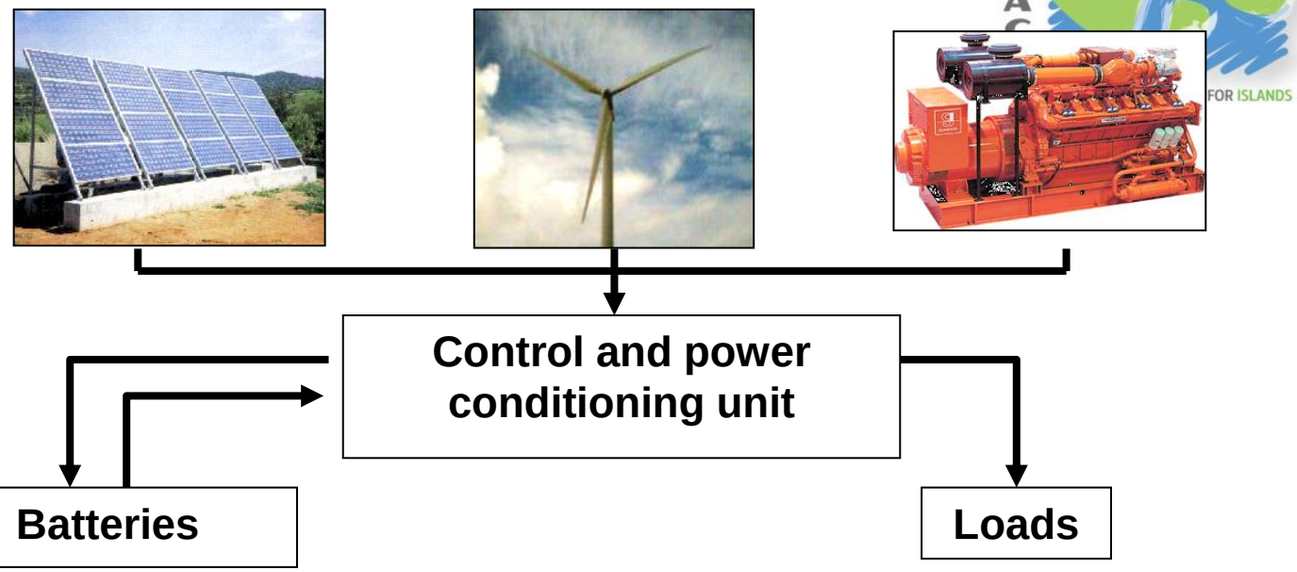
- **Determine whether the renewable energy resources are adequate**
- **The optimal size of the system components of a hybrid system: number of photovoltaic modules, power of wind generators, size of backup diesel genset, number and capacity of battery storage, power of rectifiers and inverters connecting the DC and AC bus.**
- **Investment cost of the hybrid system and annual O&M costs**
- **Economic sensitivity analysis to changes in cost , RES availability and consumption loads.**



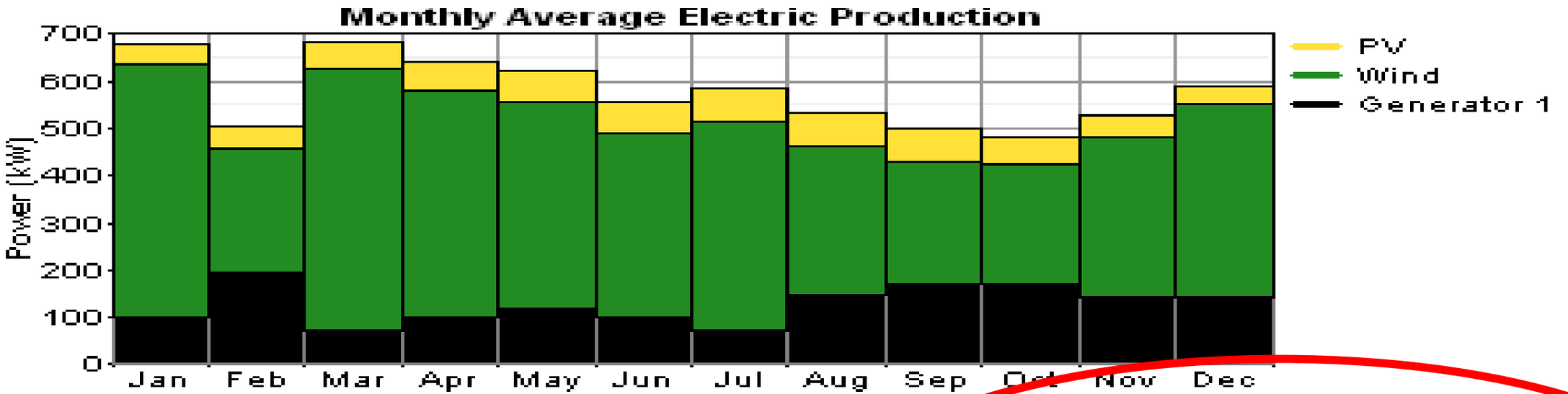
EUROPEAN COMMISSION

Minigrid for La Graciosa

The microgrid will combine photovoltaic, wind and diesel systems to supply, in a stand alone mode, the electrical needs of the island of La Graciosa.



Energy storage: only batteries



Photovoltaic	913 kWp	1.551.250 kWh/yr
Wind	50 kW	65.000 kWh/yr
Diesel	500 kW	131.400 kWh/yr
Yearly product.		1.747.650 kWh/yr
Electric demand		1.667.550 kWh/yr
Excess		80.100 kWh/yr

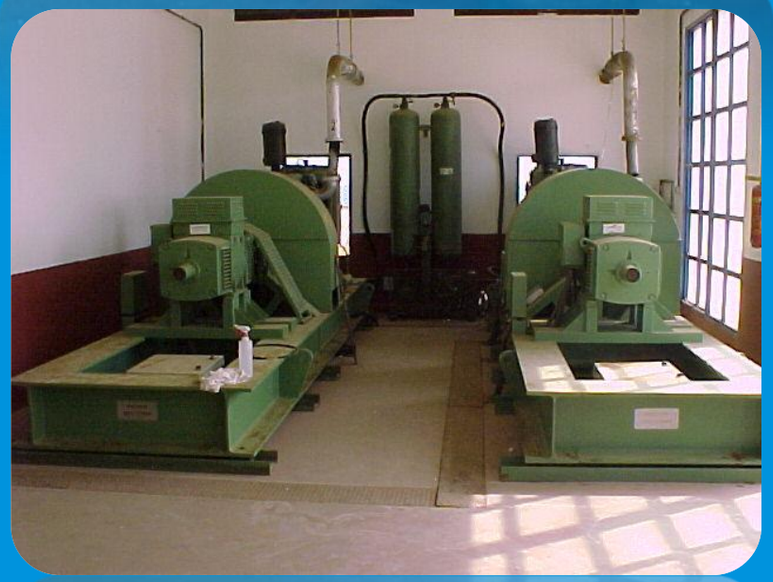
Total cost	7.062.000 €
Public support	2.547.329, €
IRR (Inc.Public suport)	12,4%

EUROPEAN COMMISSION

SMART METERS (already installed) + electric vehicles (planning phase)

Punta Jandía Wind Diesel System, Fuerteventura Island

Bankability Analysis on the overhaul of an existing singular stand-alone RES system



itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EL HIERRO

(a successful case study of public-private-partnership for the promotion of RES in European Islands)

SUSTAINABLE ENERGY EUROPE

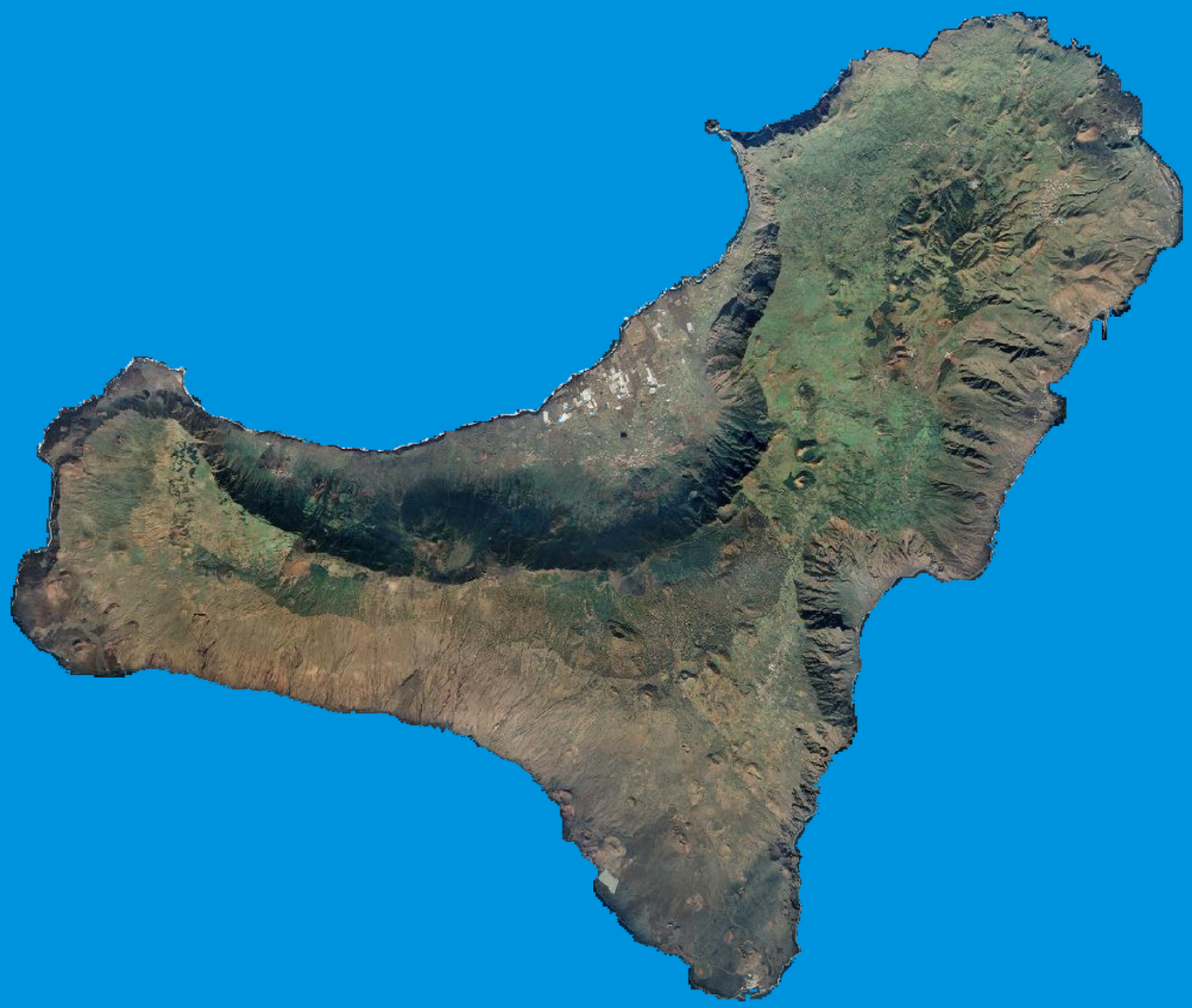
INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

EUROPEAN COMMISSION

El Hierro: 100% RES Island

Commissioning in 2013



278 km^2

10.500 inhabitants

7 MW peak

40 GWh/y demand (Diesel)

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

100% renewable energy supply

- Design and construction of a Wind-Hydro Power Station
- Installation of solar collectors & modules
- Evaluation of biomass exploitation possibilities
- Transport. Sustainable Mobility
- Environmental Education

Wind-Hydro Power Station

Gorona del Viento
El Hierro S.A.

Gorona del Viento
El Hierro S.A.

CABILDO EL HIERRO

unelco endesa

itc
INSTITUTO TECNOLÓGICO DE CANARIAS

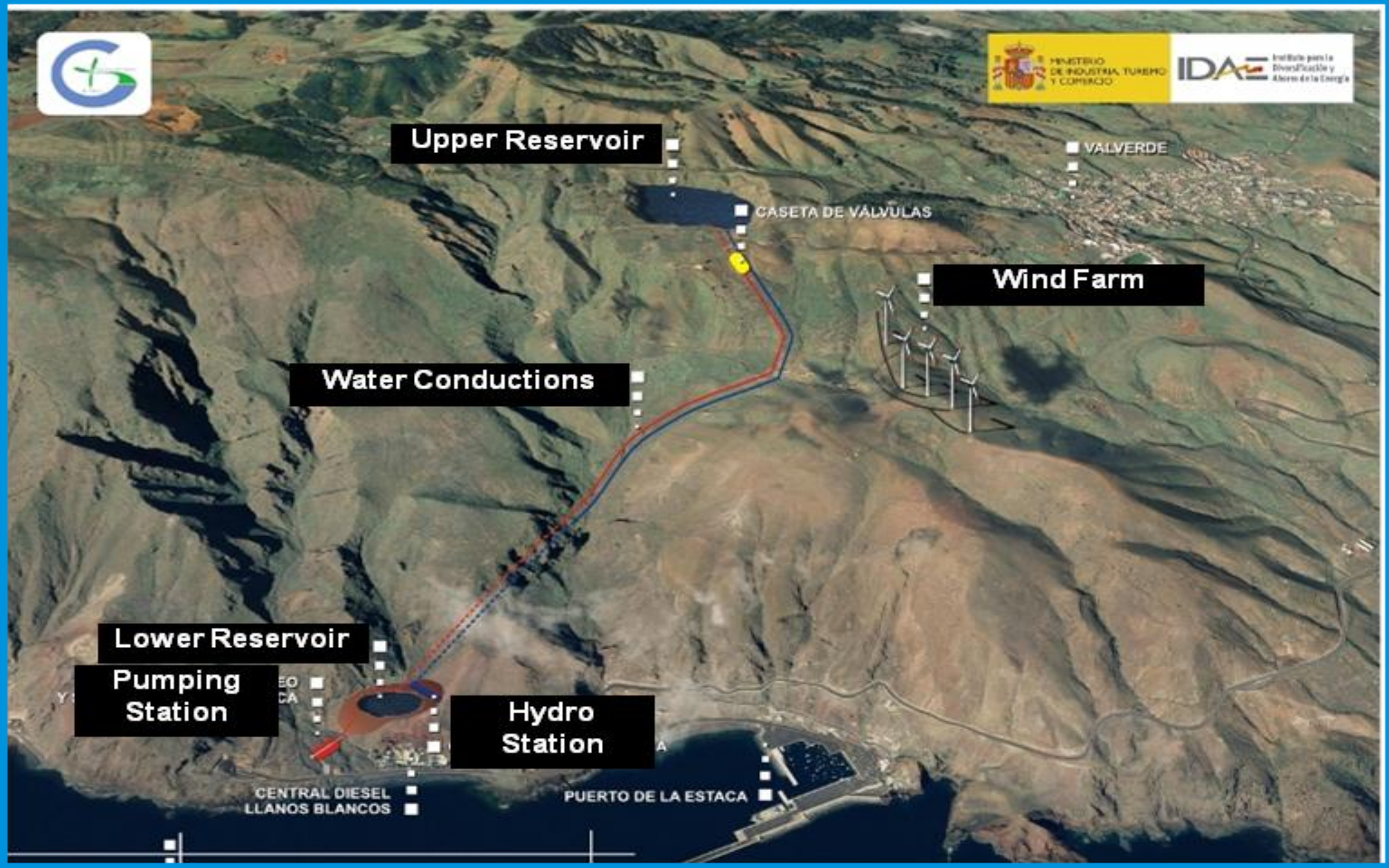
Gobierno de Canarias

MINISTERIO DE INDUSTRIA, TURISMO Y COMERCIO

IDAE Instituto para la Diversificación y Ahorro de la Energía

El Hierro: 100% RES Island

Under Construction



Wind – Pumped Hydro Power Station

INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

Wind-Hydro Power Station

Wind Farm	**11,5 MW**
Hydroelectric Substation	**11,3 MW**
Pumping Station	**6 MW**
Upper Reservoir	**400.000 m^3**
Lower Reservoir	**150.000 m^3**

BANKABLE PROJECTS

Wind – Pumped Hydro Power Station

To 100 % RES Supply

POSITIVE EXTERNALITIES

- **Emission reductions**
- **Local job creation**
- **Energy independence**
- **Improve tourist image**
- **etc,**

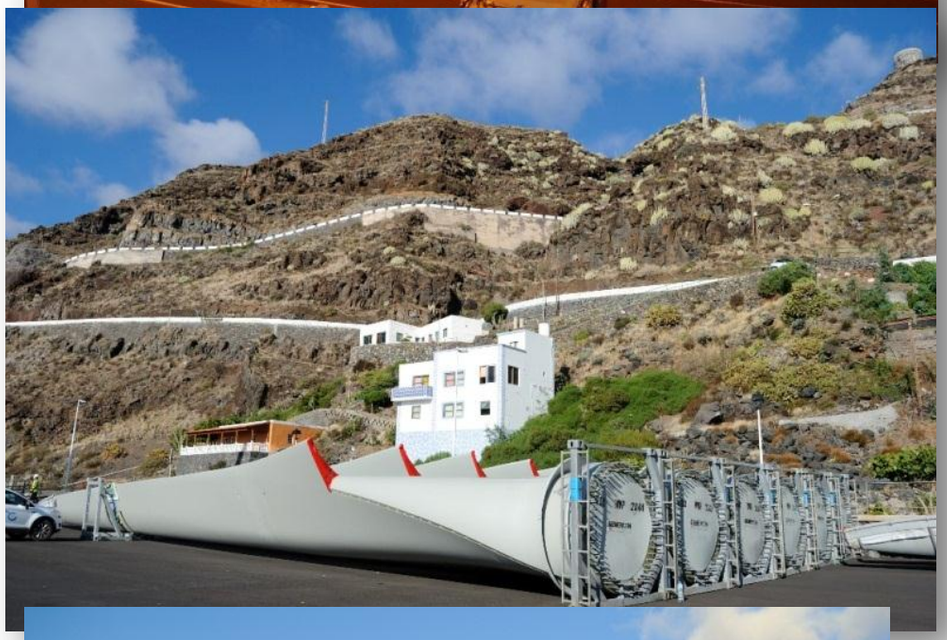
They are the justifications for the financial support of Spain's IDAE to the project, through a capital grant of 35 M€ (50 % of investment cost).

This public grant guaranties a reasonable PAYBACK of 11 years, and a IRR of 7.5 % for the private investor. Other instruments, such as special tariff schemes is being studied to raise IRR for the private investors to 8 %.

Without public support the project would not had been possible.

EUROPEAN COMMISSION

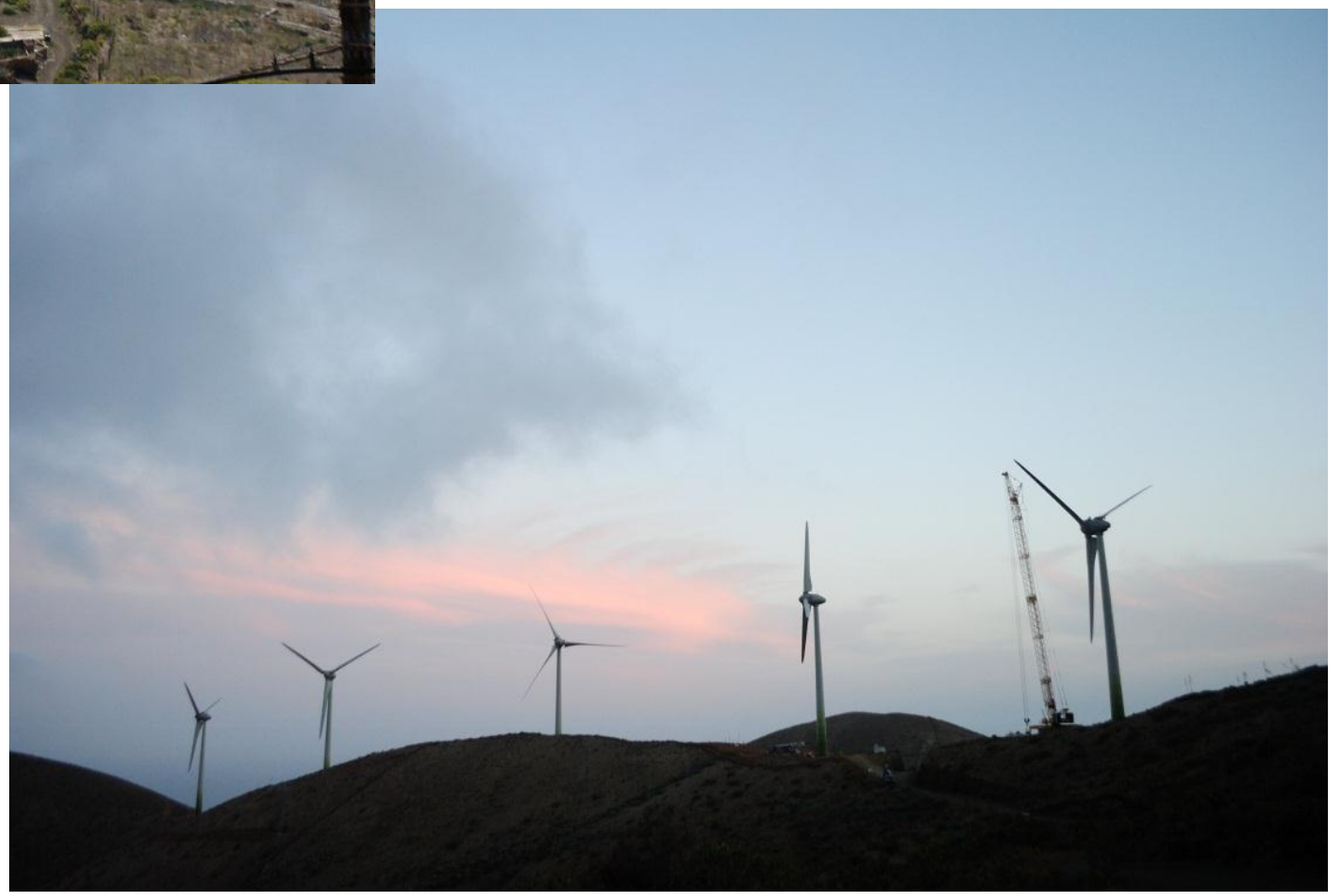

B B C




678 WP 2039
ENERCON


ENERCON
ASM
ENERGIA
SP
6501CSG


HAN
TIMIJIRAQUE
Parador
Las Playas




Edificio Central:
Subestación
Hidroeólica y
Sala de Bombas
Gorona del Viento El Hierro, S.A.


Grupos Turbogeneradores


ABB
FLOWSERVE

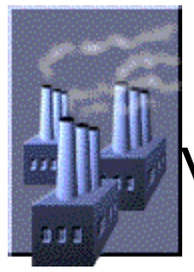
FLOWSERVE
FLOWSERVE
ABB

Wind-Hydro Power Station

SO_2

742 Tm

The systems avoids:

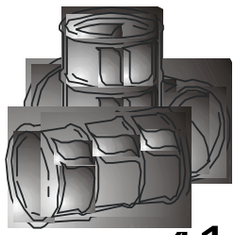


VOC

47 Tm

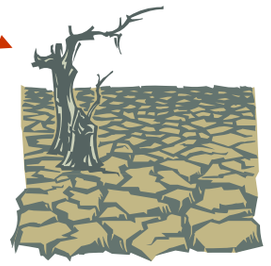
CO_2

130.118 Tm



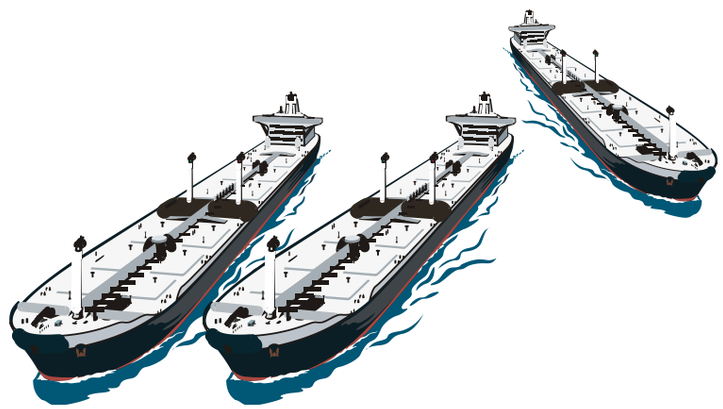
Fuel-Oil

41.257 Tm



NOx

2.697 Tm



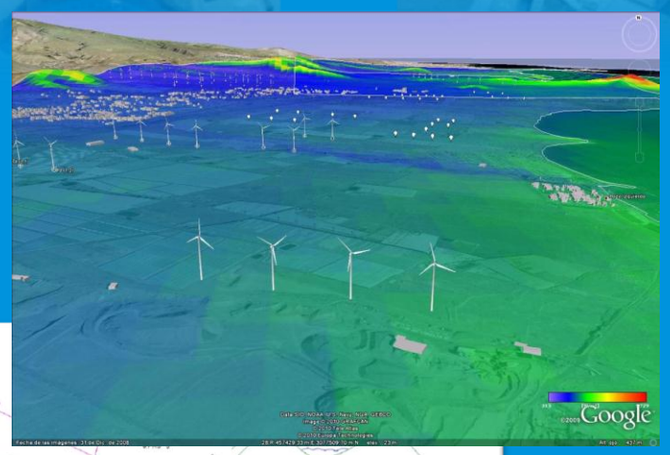
The system avoids the equivalent of 20 oil tankers of 2.000 Tm each (26 are currently necessary to meet the demand)

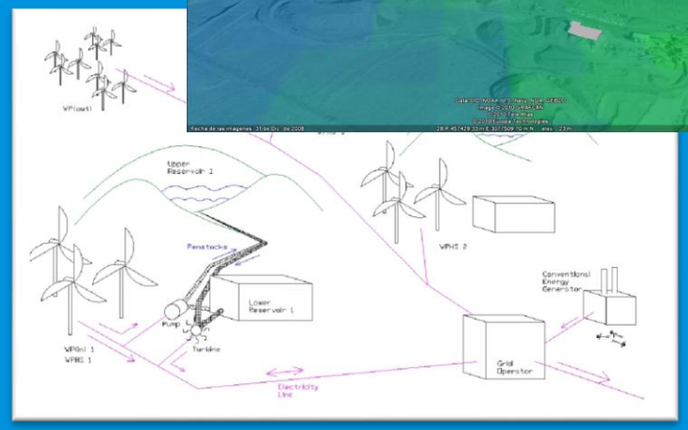
EUROPEAN COMMISSION

Maximizing RES Penetration in Insular Grids: other projects

Several Storage Projects ongoing, promoted by the utility (ENDESA) and the TSO (Red Eléctrica de España): NaS, ZnBr, Supercaps, Flywheels

Pumped Storage (Peak Shaving)





4 Plants planned: Gran Canaria, Tenerife, La Palma, La Gomera

INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias

CONCLUSIONS

Initiatives such as PACT of ISLANDS are welcome as a first step to reinforce the strong Public-Private partnership needed to promote RES and energy efficiency in European Islands.

Most RES projects involve technologies that lack the competitive maturity of fossil fuel based technologies. To attract private investors regional, national and European public support are needed.

Public benefit, in terms of positive externalities, should be the bases for needed public subventions (grants, feed in tariff, etc), to guarantee a minimum acceptable return on investment for private investors

EUROPEAN COMMISSION

Thank you!

gpiernavieja@itccanarias.org

ISLEPACT

SUSTAINABLE ENERGY ACTIONS FOR ISLANDS

EUROPEAN COMMISSION

Directorate-General for Energy

itc INSTITUTO TECNOLÓGICO DE CANARIAS

Gobierno de Canarias