“Feasibility study of hybrid renewable energy systems (HRES) to supplied energy to autonomous desalination systems (ADS) in Lanzarote and Fuerteventura islands”.

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Abstract.

In the following work the hybrid systems with base in the renewable energy (RE) are modeled to compare many different design options based on their technical and economic merits. Energy needs or power requirements will be guaranteed to reverse osmosis autonomous desalination systems (ADS), with a capacity of up to 50 m^3 of daily production. The HOMER Hybrid Systems Design Tool has been used to create optimal designs for renewable energy. The departure elements were: the electric demand of the desalination plant, the technical specifications of the equipments, as well as the potentials of solar radiation and the wind speeds of the islands under research (Lanzarote and Fuerteventura).

Introduction.

In many islands of Canary (Image 1) the desalted water is practically the unique source to supply fresh water to the population and the tourists. This share achieves the 99 % in Lanzarote, 86 % en Fuerteventura, more than 50 % in Gran Canaria and the 9.0 % in Tenerife.

The major limitation of desalination is its high-energy requirements, being a serious problem for these technologies, for the increasing environmental pollution for the use of fossil fuels.

In the following work the hybrid systems with base in the renewable energies (RE) are modeled, to compare many different design options based on their technical and economic merits. Energy needs will be guaranteed to the reverse osmosis (RO) autonomous desalination systems, with a daily production capacity of up to 50 m^3. The HOMER software has been used to create optimal renewable energy system designs. Lanzarote and Fuerteventura islands were selected for this study for their high hydric stress, total dependence of seawater desalination to supply fresh water to population and tourism and, the excellent renewable energy sources in these islands.

Desalination with Hybrid Renewable Energy Systems (HRES).

Desalination is commonly defined as the process of removing dissolved salts from saline or brackish water to make it fit for human consumption: domestic, agricultural and industrial purposes, etc. It is considered as an important alternative for the supply of drinking water, especially in water scarce regions.

The concept of Autonomous Desalination Systems (ADS), which refers to desalination coupled with appropriate Hybrid Renewable Energy Systems (HRES), offers a viable and promising option for the arid regions suffering from water scarcity where there is no connection to the electricity grid or an unfeasible network connection.

Software HOMER.

HOMER is a computer model that is developed by NREL (National Renewable Energy Laboratory) to assist in the design of hybrid renewable energy systems and to facilitate the comparison of power generation technologies across a wide range of applications. HOMER models a power system’s physical behavior and its life-cycle cost, which is the total cost of installing and operating the system over its life span. The software performs three principal tasks: simulation, optimization, and sensitivity analysis .

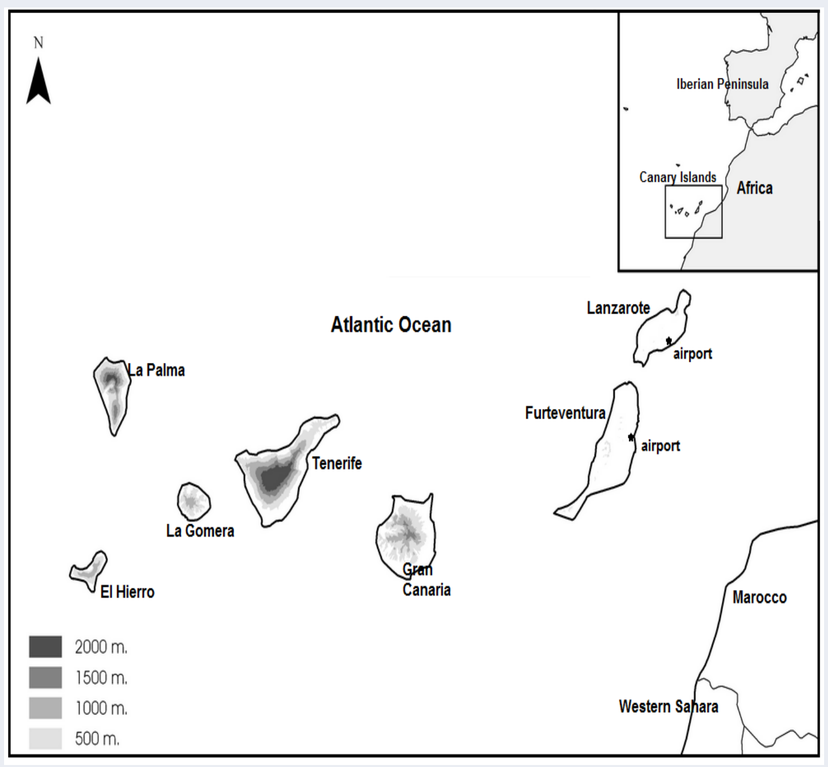

Image 1. Canary Islands.

Hybrid renewable energy system (HRES).

The hybrid renewable energy system (HRES) simulated in the current investigation consist of different combinations of photovoltaic (PV) modules and different wind generators (WT) supplemented with battery bank, it is possible include diesel generators (DG) if it is necessary, as shown in Image 2. The objective of this HRES is supplied the necessary energy to provide power to a small autonomous reversible osmosis (RO) desalination system, with a production up to 50 (m^3/day). The energy requirement of a particular desalination process is also one of the major factors affecting its cost; in this case the energy requirements assumed is 5.0 kWhelec /m^3. A small ADS with this characteristics may consume around 250 kWh/day, with an average demand of 10.5 kW and a peak demand of nearly 16.0 kW.

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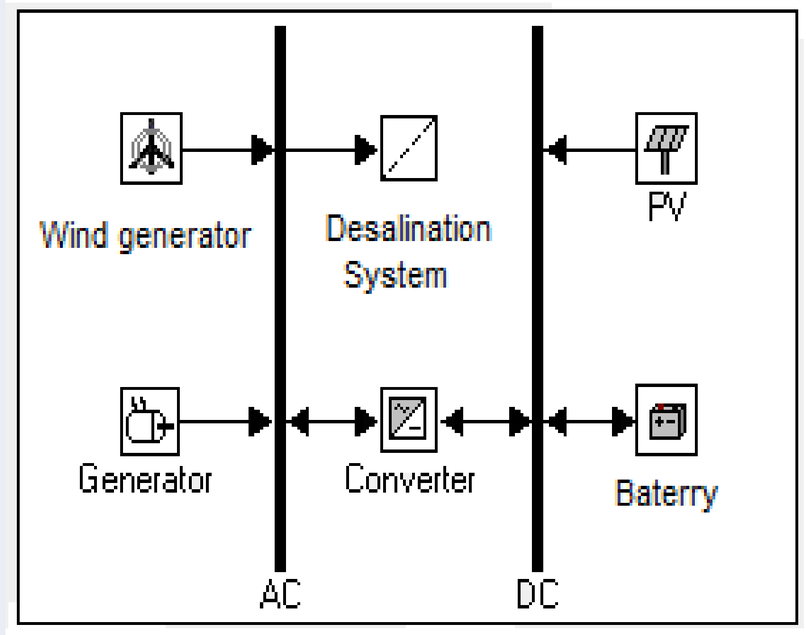

Image 2. HOMER model of the renewable energy system (HRES**).**

Results and Discussion.

The Tables 1 and 2 show the technical and economical simulation results of HOMER, for the HRES whit a total generation approximated of 250 kWh/day to supply an ADS with a capacities up to 50 m^3/day. The energy requirement assumed for the RO processes is 5.0 kWhelec/m^3 of desalted water. HOMER simulates many different system configurations, discards the infeasible ones, ranks the feasible ones according to total net present cost, and presents the feasible one with the lowest total net present cost as the optimal system configuration. The dispatch strategy used per HOMER was “load-following”.

Table 1. Technical simulation results.

Island	PV(kW)	Wind Turbine	Battery (number)	Converter (kW)	DG(kW)	Diesel (L)	GEN(hrs)	Renov. Frac.(%)
Lanzarote	5	1 – (FL30)	160	15	10	2,029	743	96
Fuerteventura	5	1 – (FL30)	200	15	15	3,822	1,152	92

Table 2. Economical simulation results.

Island	Initial Cap. ($)	Op. Cost ($/year)	Total NPC ($)	COE ($/kWh)
Lanzarote	243,000	17,993	473,013	0.404
Fuerteventura	260,500	23,448	560,247	0.478

Conclusion.

The optimized HRES to supply the ADS obtained for HOMER to the Lanzarote and Fuerteventura Island are rather approximated. They present similar renewable energy system, one wind turbine FL-30 of 30 kW of nominal power and 5.0 kW of PV panels. The differences are shown in the diesel generator and the battery bank. The generator for the Lanzarote system is 10 kW of nominal power and the Fuerteventura system, 15 kW of nominal power. The battery banks for Lanzarote system have 160 batteries and the Fuerteventura system up to 200 batteries. The differences are not so height between both hybrid renewable energy systems**.**