Designs evaluation for a micro-grid SIRTA's self consumption

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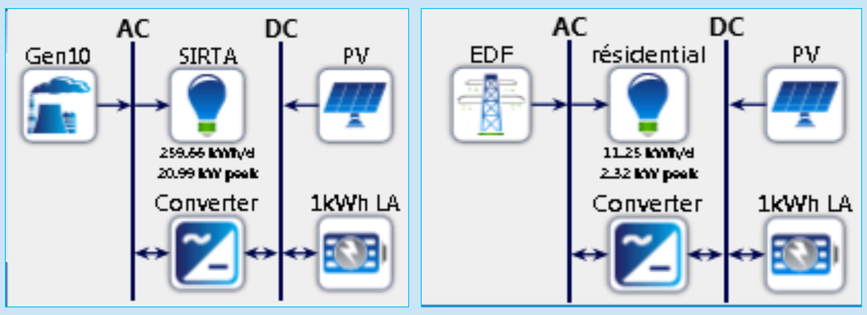
Objectives

To study the design of the SIRTA micro-grid and a residential micro-grid on HOMER (Hybrid Optimization of Multiple Electric Renewables), which allows to simplify the task of evaluating designs of both off-grid and grid-connected power systems for a variety of applications. This software allows to optimize cost and compute carbon emission and efficiency.

Designs



These schemes show the design, on Homer, of off-grid case with a buffer generator and of connected case with connection to the grid.

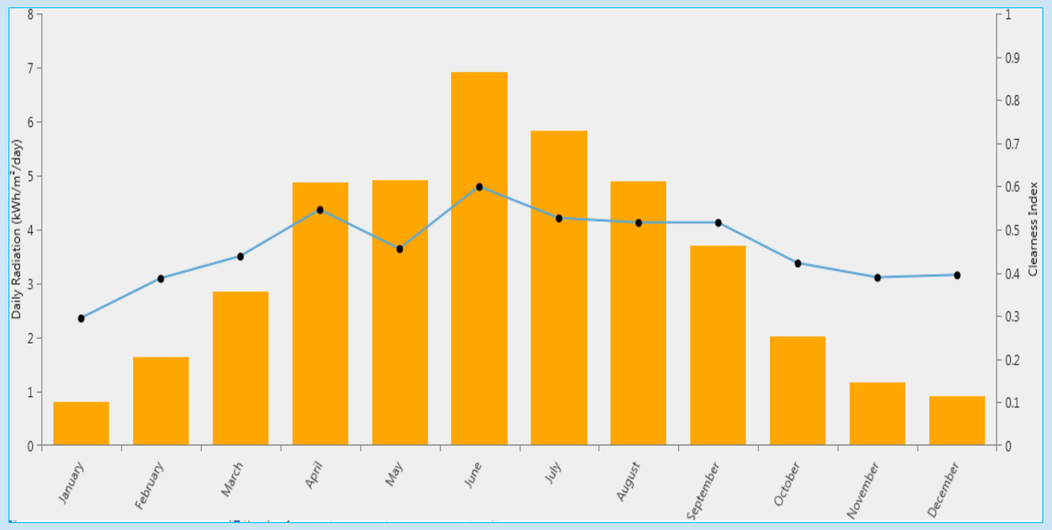
The components are:

- 12V 100Ah AGM lead-acid battery with a lifetime of 15 years
- A diesel generator
- A bidirectional converter with 15 years of lifetime
- PV panels with a lifetime of 30 years

The table below shows the cost of the different components

Cost	PV(1kW)	1 Battery 12V 100Ah	Diesel Generator(kW)	Converter (kW)
Capital cost (Euros)	4000	542	571	300
Replacement(Euros)	4000	542	571	300
O&M (euro/year)	100	0	263	0

Solar Resources



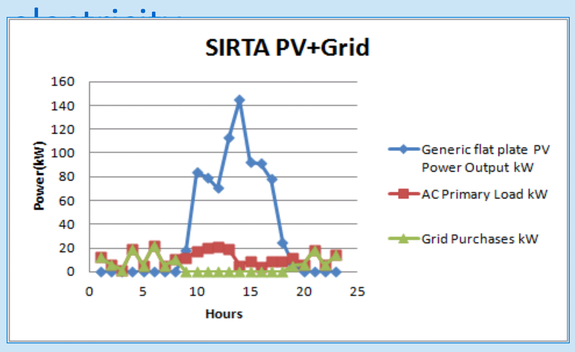
The monthly global horizontal irradiance and clearness index in 2015(in SIRTA). Irradiance is given as an input and clearness index is calculated by Homer.

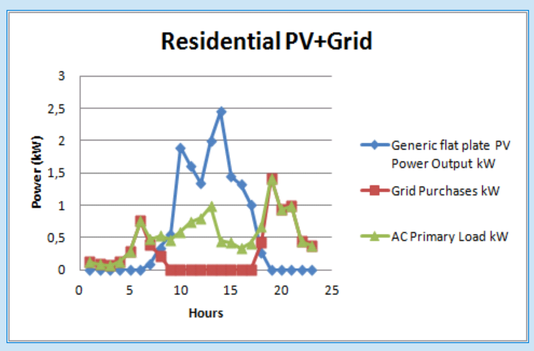
The monthly solar radiation shows a maximum in June with an annual average of 3.38 kWh/m²/d.

Grid-connected configuration

Site	PV (kW)	Battery (kWh)	EDF (Euros/kWh)	Converter (kW)	*Self-consumption (%)	*Self-generation (%)	Excess Electricity (%)
Residential	5	48	Sellback=0.24	10	42	50	0
SIRTA	200	24	Price=0.15	150	28	66	0.3

The design in the table shows when the configuration is connected to the grid there is an insignificant excess of electricity.



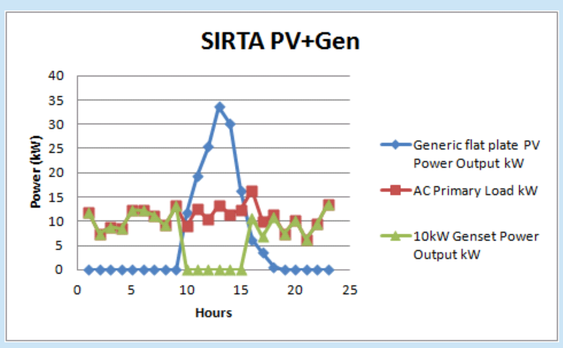


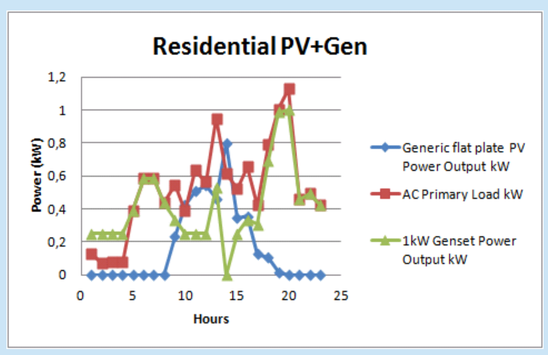
These figure illustrate the electrical production and the load demand for one day in summer. The solar panels will produce more power than the required between 9:00 to 17:00 .

Off-grid configuration

Site	PV (kW)	Battery (kWh)	Diesel generator (kW)	Converter (kW)	*Self-consumption (%)	*Self-generation (%)	Excess Electricity (%)
Residential	1	24	1	5	90	25	7
SIRTA	40	24	20	20	70	9	5

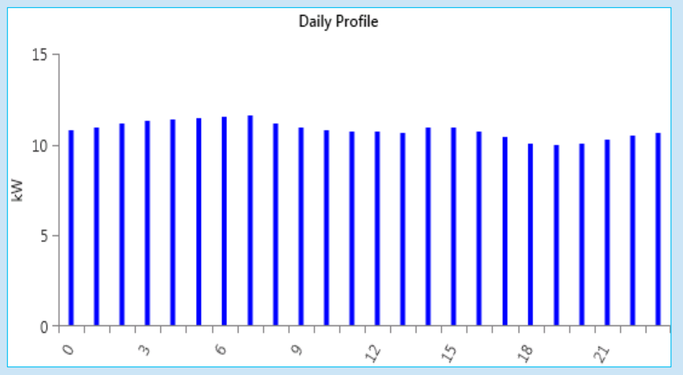
The table shows the size of the components in this architecture. The excess electricity is important due to the lack of the grid.



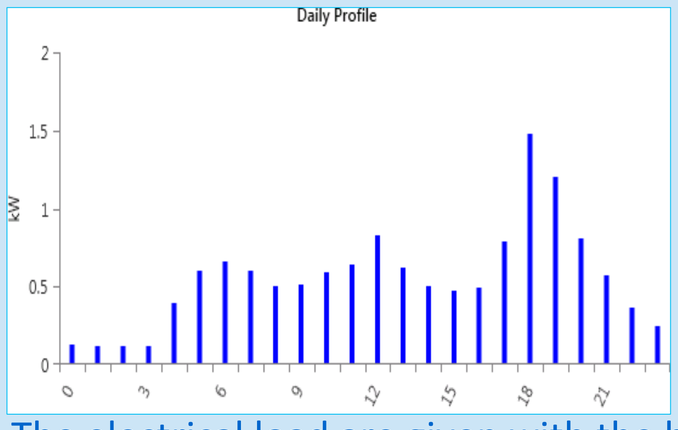


These figures show the electrical load in one day in the summer and the state of charge of the battery, they are characterized by a higher production of the solar panels from 10:00 to 15:00 which is more important than the load for SIRTA and a considerable use of the batteries.

SITE



This figure shows the hourly average electric load , the data are measured from March 22nd to June 11e 2016 at SIRTA, and given as an input to Homer. The daily profile is almost constant. The scaled annual average is 259.66 kWh/d.



The figure represents the electrical load characterized by a peak of 1.48 kW at 18:00, which is given by Homer as a typical case of a residential site.

The scaled annual average is 11.25 kWh/d.

The electrical load are given with the hypothesis of a day-to-day variability of 10% and hour-to-hour at 20%.

Conclusion

This first test is made for an introduction to Homer and advances are to be made to understand all the parameters.

The self-consumption depends on the size of the PV panels and the excess of electricity and the self-generation on the size of the PV panels and the load.

References

Cost : wattuneed.com and groupe-electrogene.ooreka.fr

*Self-generation=Renewable self-generation

*Self-consumption= Renewable self-consumption

Self-consumption: Part of the production of the renewable source consumed by the load.

Self-generation: Part of the consumption produced by the renewable source.