Study of energy flows in a building using wind and solar power in Gran Canaria isle (Spain)

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***Abstract*- Distributed Generation in buildings saves losses in transport and distribution networks, and saves CO2 emitions. In the proyect would be interesting to know the energy flow, according to horary of renewable generation and electricity consumption during the year in each building. With this information will be more easy the planifications of electric system**

I. Introduction

Global trend is the incorporation of renewable energies in buildings. This is what is called distributed generation. So we in Spain with the technician in the building code established in certain cases the obligation to implement a particular photovoltaic power. All buildings in Europe should try to be energy self-sufficient from 2019.

Every moment, all buildings will have basically two situations, the generation is greater than consumption and the inverse. In the first case the building will be pouring energy into the grid, and the second absorbing.

In the present paper is to study the effect of the introduction of solar and wind power generation in one building with a certain hourly demand, to simplify working with hourly averages, every month.

Require analysis of the simulation time of the year, and to validate the model would need to be monitored later a real installation.

In this case has made graphic monthly demand and energy resources (sun and wind). Others autor Other had analyzed buildings with power generation.

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If every building were be analized, it would be possible to know electrical network performance, improving its operation and protection.

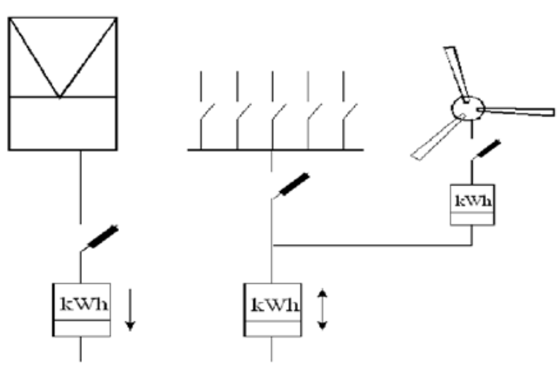

Fig. 1. Electric line diagram

In Spain, all the PV generation is poured to the grid because it has an attractive rate. In the case of the wind generation there are two option: to register as a producer, which means high costs for a small facility, no one does. Or register as self-producer. In which case the rule requires to consume at least 50% of annual production.

The turbine will be connected downstream of the electricity meter within the property and the PV system would be connected directly to the distribution network with your accountant and an independent connection.

Once you set the daily charts for each season of production and consumption is the energy difference into or out from the network.

The savings in losses will be proportional to the generation by own self. Although the reality is that the save energy is greater, because the energy into the network could be consumed in adjacent buildings, and it would not from a far away power station.

In the Canaries, the transmission and distribution losses are about 10%.

Currently, in Spain, it is estimated that energy consumption in the residential sector is around 25%, making it the second largest behind the transport sector. Energy demand in a building depends on many variables, but one can say that the biggest expense is due to air conditioning (heating and cooling) with a percentage of the total consumption of about 42%, followed by consumption to produce hot water with 26%, operation of various electrical equipment and kitchens with 23% and 9% illumination.

The reality is that in Gran Canaria due to the low level of industrialization and the moderate climate (no heating or air conditioning is necessary), the percentage of residential electricity consumption is bigger.

The solar and wind resources are well know, so it´s easy to estimate the hourly production.

II. Characterization of Consumption

First we studied the monthly pattern of consuming the building, in this case is a school. In general, most of the year is the same, except during the summer.

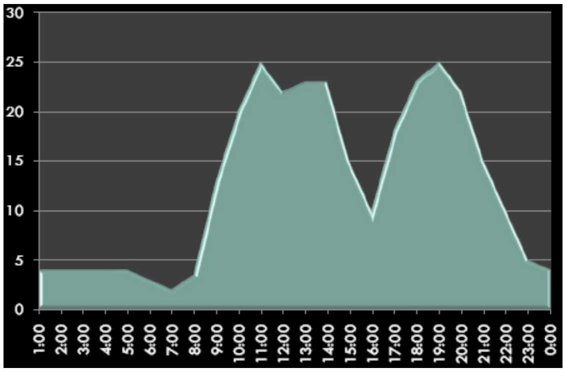

Fig. 2. Daily consumption during the academic time. (kW)

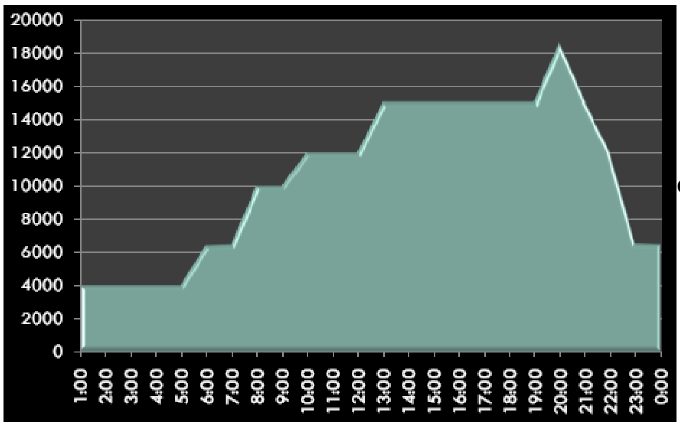

Fig. 3 Daily consumption during summer holidays (W)

During the summer the center is used for summer courses and extend their operating hours. It has also considered the non-school days and weekends.

Individual house loads are highly variable in time and between houses. It´s necessary to create and use high-resolution time-series data for each and every house and commercial property connected to the network. [1][2]

III. NATURAL RESOURCES

A. Solar Irradiation

There are many sources of data on solar radiation in the Canary Islands, given the high altitude of the islands it varies greatly depending on the orientation. The radiation measurements made by the ITC in the city of Las Palmas de Gran Canaria has been used.

It has gone from average daily values to hourly averages values, for it has been used conversion factors revealed by Lui and Jordan. Subsequently it has been broken down into direct and diffuse radiation for the plane forming the panel with the horizontal, using the concept of clearness index.

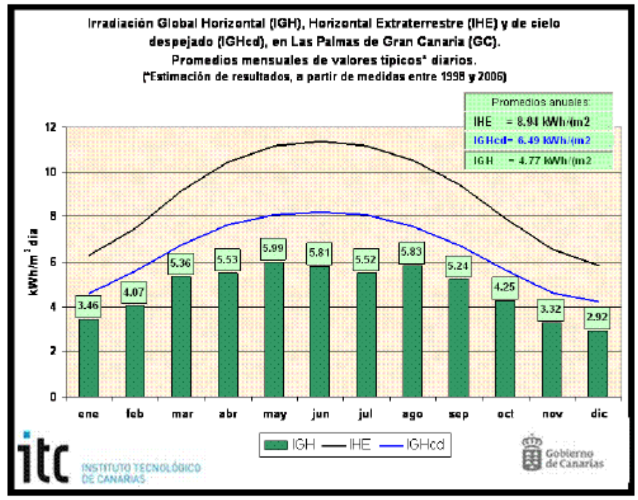

Fig. 4 Daily solar radiation, monthly average

Based on these values and for a particular facility we have obtained the hourly production for each month of the year.

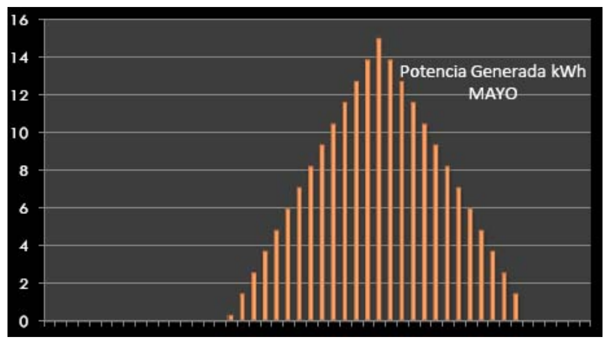

Fig. 5 Photovoltaic generation (kWh)

B. Wind speed

It has average hourly base in the area. The selected city, isn´t the best wind place on the island.

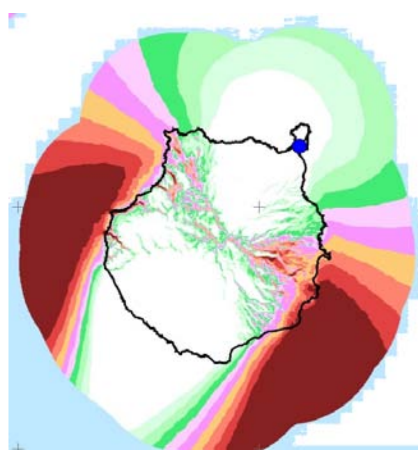

Fig. 6 Wind speed in Gran Canaria

In the case of wind, since the use of average values of wind leads to large errors, we worked with power generation data from several existing wind farms in the area, during several years.

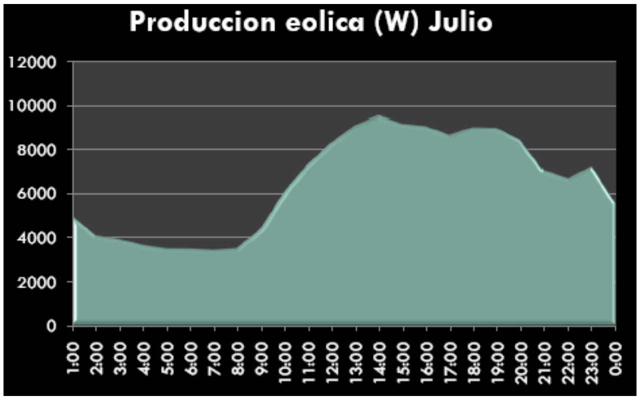

Fig. 7 July Wind Generation (W)

Maximum monthly production is july, and are the first hours afternoon the windiest.

IV. ENERGY FLOW. RESULTS.

A. Curves of energy flow

In the case study, we note that the installation is poor. Being only a few summer months during certain hours when the building poured into the grid.

In any case it is relevant the energy saving that is achieved, relieving networks especially around noon and early afternoon. Here two months data are showed, one of then with a large energy deficit and the other one with some hours during that the energy is injected into the network.

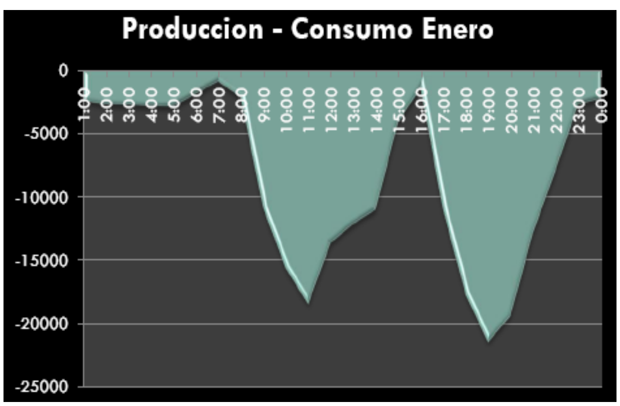

Fig. 8 Energy flow in January

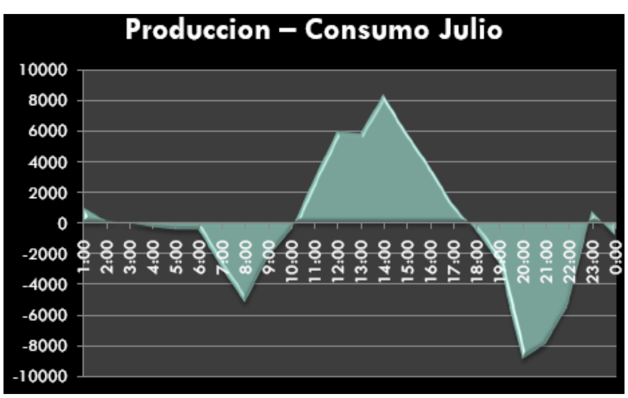

Fig. 9 Energy flow in July

A. Energy Balance

The annual balance is quite satisfactory in our case, since the datas are:

- 54 MWh are absorbed from the network
- 43 MWh are self-service
- 4 MWh is discharged into the network

These values obtained in the case study vary greatly depending on the demand profile, of the seasonality of it. Just as the nature and use renewable power is adopted, time and seasonal distribution of the energy resource at the site chosen.

So if in this case the degree of self-sufficiency is 44% and is discharged into the network only 8.5% of the energy.

There are several studies on the flow of electrical power in buildings. [3]

V. CONCLUSION

The massive use of renewable energy exploitation in buildings will result in energy flows that will depend on many factors. Consideration should be given at each site, to avoid saturating the networks.

The demand uncertainty is compounded by the changeable power generation. It would therefore be advisable to make in each case a temporal analysis of the whole zone. And provide the installation of load management devices, which connect and disconnect devices according to availability and weather forecasts.

Today in spanish buildings only is installed photovoltaic power, because their bonus is high. This has led to the picaresque and scams.

Soon the prices will be independent of the nature of the generating device, (wind, sun, waves..), being the price of energy in the market the same for any technology. Down the prices in times of surplus and vice versa. Smart grids will allow the management of the system.

The domestic energy storage devices have much play in this situation: ones of low capacity to cover the jet lag, and big ones for medium and long term, to cover the fluctuate energy seasonal.

VI. REFERENCES

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