Photovoltaic energy and the environment

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Abstract

There are several ways of implementing a PV systems networking site, depending on the income that you would like to achieve. Fixtures can be built with solar tracking axis and two axes solar tracking. In this work we make a detailed comparative study of the implementation of a solar photovoltaic installation in a particular place, the three systems mentioned above. The study was performed from both constructive, analyzing the structural components of each of the systems, such as energy level, from the standpoint of performance and results achieved over a period of time. Obtaining criteria allow, in specific cases, the best choice.

In the present work, we will also study the different models needed to obtain the appropriate permissions for the implementation of the system chosen between the ones explained above. Studies which analyze the environment surrounding the facility: the flora, fauna, hydrology and winds in the area or Environmental Impact Study. As well, the impact that the construction of an installation of this magnitude affects visually the area where it is located or Study of Landscape Integration.

Keywords: solar photovoltaic energy, environmental study, landscape study, installation.

1 Introduction

Over the past few years the decrease in the price of the components of solar photovoltaic installations, especially modules and investors, coupled with improved reliability and performance of the latter devices has given rise to a new application: the connection to a photovoltaic network.

The direct conversion of solar energy into electricity through photovoltaic cells has been developed in recent years, in many countries, as an alternative

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power supply. On the occasions where the power supply for conventional network already exists, the tendency is for photovoltaic cells work with it.

2 Object of work

The purpose of this paper is to define, technical and environmental parameters of the infrastructure necessary for the creation of a solar photovoltaic installation connected to the electrical network. Such an approach implies comparing together various mounting options and selecting the most beneficial for a particular case.

Installation of photovoltaic systems with networking capacity, in general terms consists in generating electricity from solar radiation a renewable energy source. It consists of a photovoltaic array that produces energy in direct current (DC) and by a processing system that converts alternating current sine wave in perfect synchronism with the grid of the company.

3 Location of the photovoltaic system

Municipality of Pinoso, province of Alicante. Plot 165. Polygon 3. Plot coordinates, UTM: X = 674664.10 Y = 4. 259,841.62, latitude: N 38 º 28 '4.99", W 0 ° 59' 56.69".

Application: Production of photovoltaic power.
Class of installation: electrical energy production in the Special Regime.
Generated Rated: 400 kW.
Minister voltage: 240 V.
Maximum allowable power: 420 kW.

4 Installation components

4.1 Photovoltaic modules

The set, called a photovoltaic panel or module, is composed of a specific number of interconnected solar cells properly assembled and protected against external agents (the cells are very sensitive). After completion of electrical interconnections, the cells are encapsulated in a structure called "sandwich."

4.2 Investors

Investors can convert the DC produced by the panels into alternating current of 125 or 220 V.

The downside is that this transformation leads to the inevitable loss of power to the investor, which, as we shall see, in some cases the performance we get is very small.

4.3 Support structures

4.3.1 Fixed support

4.3.1.1 Modules inclination The performance of the panels depends on the angle of incidence of the beams of the sun on its surface. Maximum performance is obtained when the angle of incidence of solar beams on the collector is 90 °.

Table of values obtained in the study site. N38º 28'5", W 0 ° 59'57." Plot 165, Range 3 of Pinoso, Alicante.

Table 1: Modules inclination per month.

Month	Optimal Inclination (degrees)
January	62
February	54
March	41
April	25
May	13
June	5
July	9
August	20
September	36
October	50
November	59
December	64
Annual	**35**

4.3.1.2 Minimum distance between rows of panels Line spacing of panels is set so that at noon's during a low illumination day (minimum solar altitude) to the time period, the shade of the upper edge of a row must be intended, at most, on the lower edge of the next row. Be taken into account the table of solar azimuths and altitudes presented in this report. In this case the inclination of the panels is: **28.5**.

From pre-calculated loads for the study area and ease of assembly and special use for this type of installations, we will use metal sections HILTI. The latter is composed of galvanized metal sections specially designed for easy mounting of PV modules.

The structure is divided into a primary structure called rocker and a secondary structure cross-linking the different rockers separated one from another a distance of 2 meters.

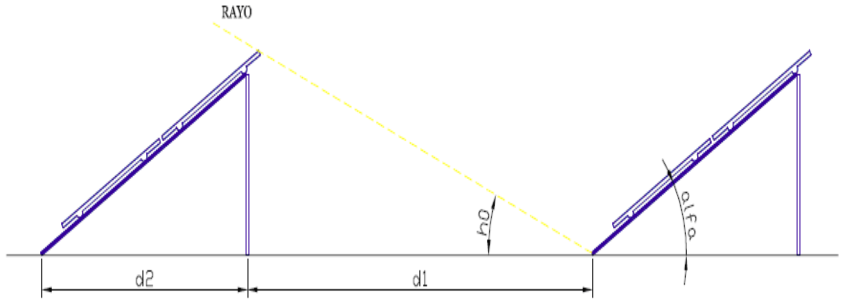

Figure 1: Minimum distance between rows of panels.

$$d = d_1 + d_2 = \frac{z}{\tan(h_0)} + \frac{z}{\tan \alpha} = \frac{l * sen\ \alpha}{\tan(h_0)} + \frac{l * sen\ \alpha}{\tan \alpha}$$

$$d = l * \left(\frac{sen \alpha}{\tan(h_0)} + \cos \alpha \right)$$

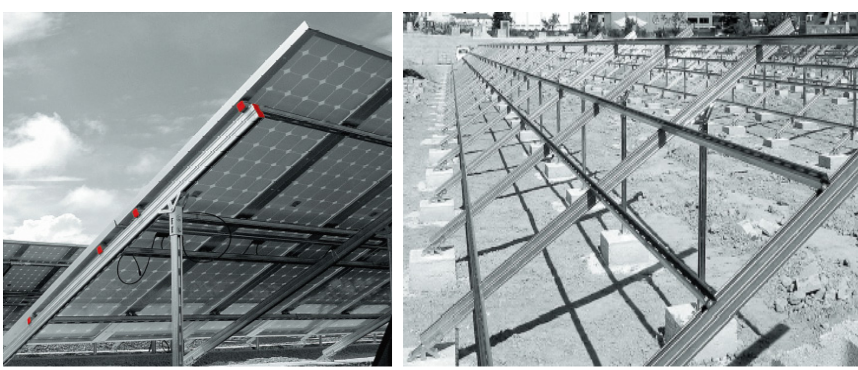

Figure 2: Fixed installation photovoltaic.

4.3.2 One axis trackers

The one axis Solar Tracker is a power equipment in its upper part has fixed the PV modules and getting the sunshine on them is high, all the structure moves from east to west on an axis or structure that can rotate 270 º (azimuth tracking.) With these teams, the panels are oriented so that they are always directed toward the sun, thereby increasing performance.

Looking to maximize, in a first step, the production of photovoltaic energy from optimizing the resources provided by the sun, the axis solar tracker with fixed azimuth tracking is designed and manufactured to maintain the inclination of the panels in the optimum tilt.

Figure 3: One axis solar tracker.

The monitoring system to an axis is done by astronomical programming and a PLC controls the operation included the motorcycle gear causing the follower to follow the path of the sun from dawn until dusk, therefore getting the optimal orientation with respect to the sun throughout the day. The overall process will allow maximizing the total daily solar radiation received by the panels. According to the previously stated approach, we offered some increases in the performance of the systems with an axis solar tracker, for the facilities on fixed structures above 20%, reaching up to 30% in some regions of Spain.

4.3.3 Two axis trackers

The two axis Solar Tracker are power equipments, its upper part has fixed PV modules and sunshine exposure on them is high. All the structure is moving from east to west on an axis that can rotate at 240 ° (azimuth tracking) and a second axis tilt from 60 ° to the horizontal position. Therefore the panels are oriented so that they are always directed toward the sun and thus increase performance.

Figure 4: Two axis solar tracker.

Results showed that this setup allowed performance increases because of the dual-axis solar tracker. Facilities on fixed structures showed increased yields greater than 35% in most cases and reaching up to 45% in some regions of Spain.

The annual production of each of them is:

Fixed: 951826,52 kWh.
One axis: 1015405,49 kWh.
Two axis: 1116412,96 kWh.

5 Production

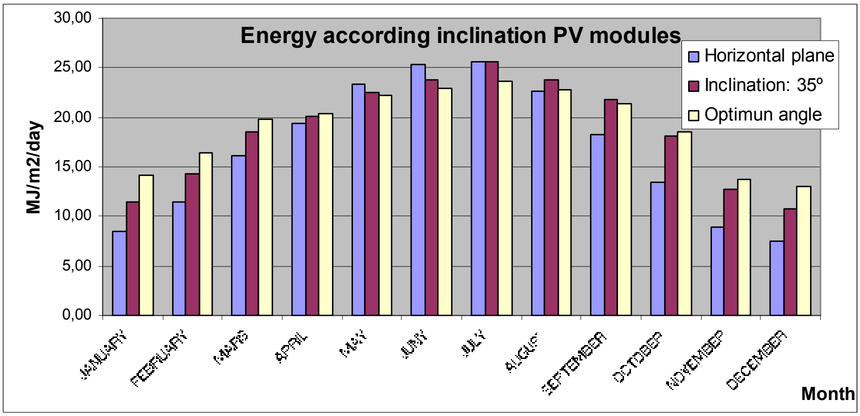

Figure 5: shows the difference between a system where the panels are in an horizontal plan with respect to the sun in comparison with other systems where the angle is fixed at 35^{o} or varied optimally with the position of the sun.

According to the results of calculations of production, we chose two-axis trackers. Leaving the installation plant:

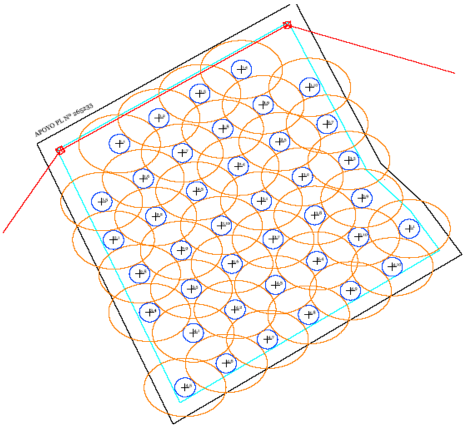

Figure 6: Plant of the installation.

6 Environmental impact study

At this point the aim is to make a detailed study of all factors that may affect the environment of the photovoltaic installation. This activity should be harmless but it is necessary to ensure that this study poses no danger to the natural resources of the area [4–7].

Different factors are considered in this study are:

- ❖ Natural resources
- ❖ Construction and operation [8]
  - ✓ Vibrations
  - ✓ Heat
  - ✓ Odors
  - ✓ Light Emission
  - ✓ Waste
  - ✓ Spill
  - ✓ Matter and energy emissions
- ❖ Evaluation of direct and indirect effects [8–11]
  - ✓ Population
  - ✓ Soil
  - ✓ Air
  - ✓ Water
  - ✓ bioclimatic factors
  - ✓ Tangible property
  - ✓ Heritage
  - ✓ Habitats
  - ✓ Geology and geomorphology
- ❖ Measures planned to reduce, eliminate or compensate for significant environmental effects

Given the null conditions resulting from the process of establishment of the photovoltaic plant, was not considered an alternative option and are prepared to suggestions from the Administration in order to reconcile the safe operation of the photovoltaic plant with the environment.

7 Study of landscape integration

These studies have been going on for a couple of years now (indicate the number of month/year) and involves studying the integration of any facility that is intended to perform with the surrounding environment. Pretending the minimum visual impact from any angle [7, 12, 13].

The study consists of the following parts:

- ❖ Purpose and justification of the study
- ❖ Description of the action
- ❖ Scope of performance
  - ✓ Landscape unit
  - ✓ Landscape resource
- ❖ Plans or rules
  - ✓ Urbanistic and landscape planning
  - ✓ Territorial action plans incidence study in the municipality
- ❖ Public Participation Plan

8 Conclusions

The study of a solar photovoltaic installation with network connecting showed that this was a harmless activity that gives us a fairly broad leeway in covering the specific energy demands, and therefore unexpected, of a population without the need for conventional energy and more pollution.

The way of implementing this system greatly improves the yield obtained which may lead to an overall greater amount of energy. The selection of one method or another can be seen not only from a production point of view but it could also be done from an economic standpoint. A longer follow-up also requires a larger investment which could be recovered in a shorter time period.

With regard to environmental considerations and landscape integration it is possible to state that it does not affect in any way the environment surrounding the activity, because its construction requires only minimal structural elements. Virtually all parts could be pre-fabricated, thus saving time, money and fieldwork.

Its integration in the landscape depends on the area where we want to construct the PV installation. Fleeing villages, main roads, considering establishing in plots of low ecological value from all points of view.

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