Photovoltaic Trees Network for Electric Power Generation and Carbon Sequestration

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Introduction

The issue of electric power generation, as well as the demand needed to meet consumers' electricity demand, means that more and more means are being explored for electric power generation [6].

We currently have energetic matrices distributed all over the world, and all of them mainly use natural resources to generate electricity. The means that electric power generation through natural resources are the cleanest means for this type of generation.

Emphasizing that all types of electricity generation brings to the environment such as carbon emissions [7].

Thus, this article aims to present a proposed network of photovoltaic trees for electric power generation and carbon sequestration.

Renewable Sources

The use of renewable sources for electric power generation is considered the cleanest medium for generation of the same and presents less damages of degradation of the nature, fauna, flora and use of the soil. In the days now electric power concessionaires, they started betting on the model of micro electric power generation, with application mainly in the urban environment, where for example roofs, facades of buildings can be coated with photovoltaic plates capable of meeting totally or partially the demand of electricity of the installed load.

Another alternative for the generation of electric energy through photovoltaic panels, is the use of photovoltaic trees, they are an interesting solution to be integrated into the infrastructure of: urban centers, parks, schools, universities, squares, etc. The composition of these trees is basically composed of a metallic stem (trunk) for central support and then metal couplings (branches) to support the photovoltaic panels (composing the canopy format) [5].

The projects and implementation of photovoltaic trees are seen as a good opportunity to generate clean electric energy directed to urban centers, public places, shows and events, because they occupy reduced air and contribute with social energetic mobility [8]. Figure 1, shows the modeling of two photovoltaic trees installed in urban areas.

Fig 1 – Modeling of two photovoltaic trees installed in urban áreas [8].

Carbon Emission

The biosphere is constantly susceptible to continuous processes of transformation due to natural causes, over which man has no control [2], however, man, along with urban growth, has been intensifying such processes, mainly due to the burning of fuels and the release of greenhouse gases into the atmosphere. The consolidation and advancement of scientific certainty about man's influence on global warming, and environmental disasters, result in the need to adopt consistent targets for reducing greenhouse gas emissions [1].

Due to the already known need to minimize global warming, legislation and commissions were established in the early 1990s to set targets and create mechanisms to reduce greenhouse gas emissions [3, 4].

Method and Materials

The methodology of this work consists in the calculation of photovoltaic modules for the generation of electric energy, to be installed in a tree typology and then to be interconnected in a network to distribute the electric energy produced, taking into account the projected load.

With this also calculate through a carbon calculator the amount of the same that would be sequestered through the test type of electricity generation cleanly.

Results

In this section, the autonomy values of the system were calculated to generate electrical energy for the equipment present in Table 1, with autonomy of the system of 2 days.

Table 1 - General equipment information and usage characteristics.

Quantity	Type of electronic device	Power (W)	Time of use (hours/day)
03	Router Wifi	6	24
12	Mobile phone charger	5	12
06	Notebook	60	12

➢ **Calculation of Total Power Consumption**

Device Consumption = Device Quantity x Device Power x Period of Consumption. C **Wifi Router** = 3 x 6W x 24 hours = 432Wh; **C Cellular chargers** = 12 x 5W x 12 hours = 720 Wh; **C Notebook** = 6 x 120W x 12 hours = 2880 Wh; **Total=** 4032 Wh.

➢ **Energy of Autonomy**

The energy of autonomy is calculated, taking into account the consumption energy and the number of days of autonomy, desired for the system to act, this calculation is represented by the following expression:

EA = ECxNumber of Days of Autonomy.

EA = 4032Whx2days= 8064Wh or 8.06 KWh.

➢ **Number of Photovoltaic Modules**

The type of photovoltaic module selected was the LD135R9W type, which provides 410Wh of energy daily in a 5 hour daily sunshine arrangement, considering its maximum current. In this application the battery bank operates with 24V. Mandatorily using 2 modules in series and the others in parallel to be determined next, given by the following expression: N = Ec / Ep.

Where: **N** = number of modules used in the system;
Ec = Energy consumed daily in the system (Wh);
Ep = Daily energy produced by module (Wh).
Soon:
N = 4032Wh / 410Wh = 9,83. Considering the worst case will be used 10 modules.

➢ **Comparative board**

Calculating on the potential of clean energy generation, with the photovoltaic energy produced by the installation of the panels in tree typology 120.96 KWh / month. This represents 3628.8 KWh / year, corresponding to 0.49 tonnes of less carbon emitted into the atmosphere (per year) or carbon sequestration emitted by the consumption of the appliances. Taking for example the compensation rate of planting a tree, the Figure 2 shows the electric installation scheme of the modules for the composition of the photovoltaic tree.

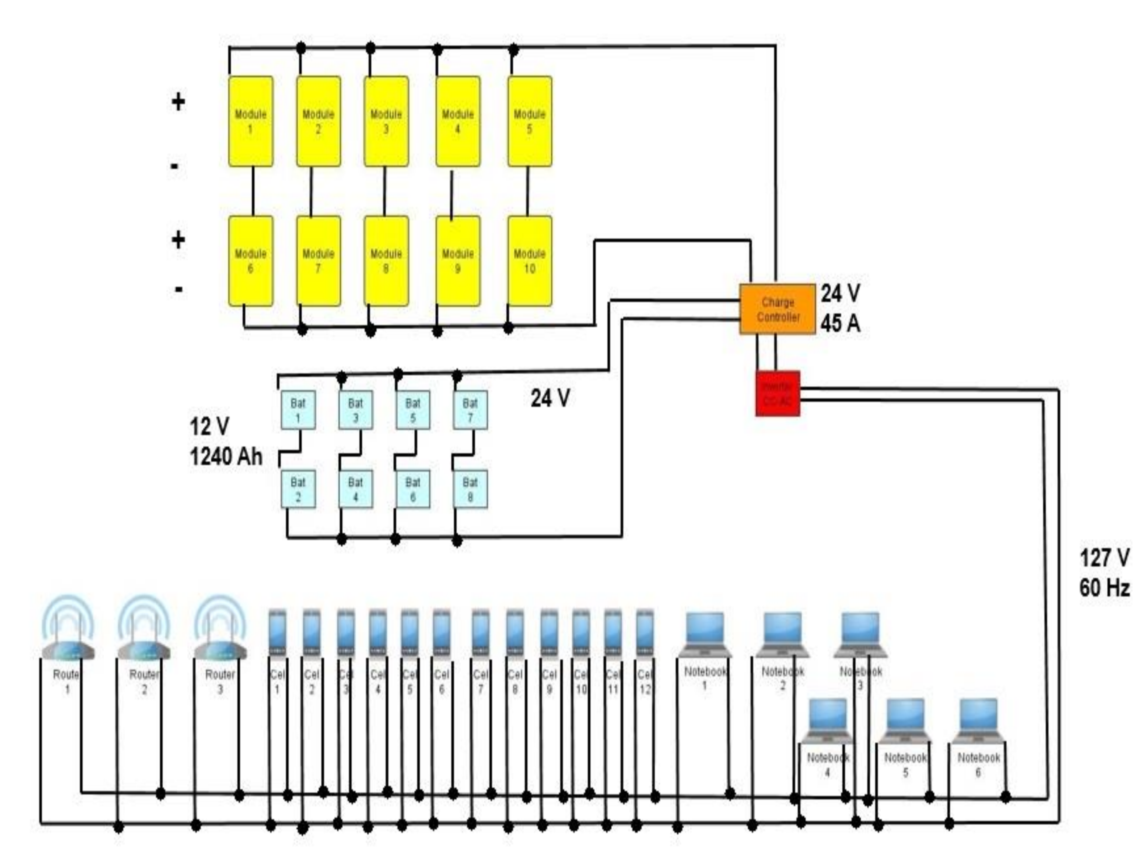

Fig 2 – Schematic of the installation of the modules, for composition of the photovoltaic tree.

Conclusion

In addition to the benefit of generating clean energy, the tree brings shade and good star to the population that uses it. With the project, it was also possible to calculate the amount of carbon that would be emitted if this source of energy were not renewable, which would be about 0.49 tons of CO_2, which, with the use of this technology, can be reverted in a sequestration, resulting in environmental benefits such as the decrease in temperature in large centers, focal point of project utilization.

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CAPES