Economic Viability of Photovoltaic System in Educational Building in Lorena

Abstract – This work will show a study of the economic viability for a photovoltaic system, connected to the electric gria and to encourage the use of alternative energies, such as solar energy, the parameters for the installation of a photovoltaic system in the educational building of the Salesian University Center of São Paulo, São Joaquim campus in Lorena, are analyzed and calculated and the requirements of electrical engineering area to the this kind of an autonomous energy generation. Finally the paper will show the results of this concludes the case study, referring to the economy that kind of generation system may provide, related to the initial investment payback.

Keywords -- Photovoltaic System - Alternative Energies - Solar Energy - Economy - Payback.

I. Introduction

Your goal is to demonstrate the evaluation results of a photovoltaic system's implantation in an electrical system analyzing the possible gains in electricity costs in the Mario Bonatti building, located in the city of Lorena, in the city of São Paulo State.

A. Methodology

We will use the case study as a research method of the work and refers an installation of grid-tie photovoltaic system in a school building and supplies the whole building lighting and consequently reach a possible decrease in the energy. This methodology "is an empirical study that investigates a current phenomenon in the context of real life" (Miguel, 2012 p.132).

II. The Definition of the Photovoltaic System

The studied educational building, Mário Bonatti, has the prefect area for the system installation (width: 25 meters and length: 45 metrs). The building roof was the basis to derived the solar panels area installation and the photovoltaic system that should the whole building lighting system.

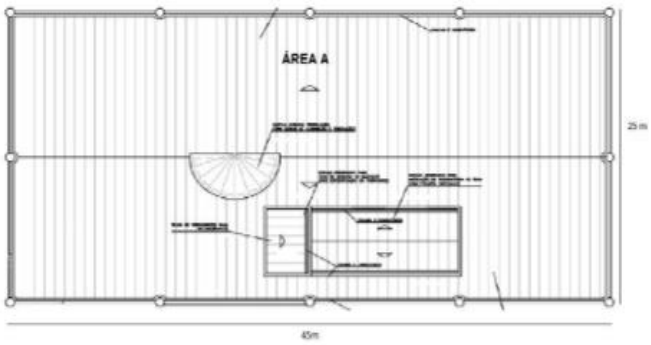

Fig. 1 Roof of the Mário Bonatti building.

The building lighting system is composed by 308 luminaires, being used in all 616 lamps, fluorescents with 54 W, adding with the respective reactors. The student service period begins at 8:00 am and ends at 10:30 p.m. However, classes take place in the morning, from 8:30 am to 11:35 p.m., and at night from 7:00 p.m. to 10:30 p.m. The monthly costs of the building, in reais, are shown in Figure 2, with the amounts paid to the local concessionaire, EDP Bandeirante, for 2014.

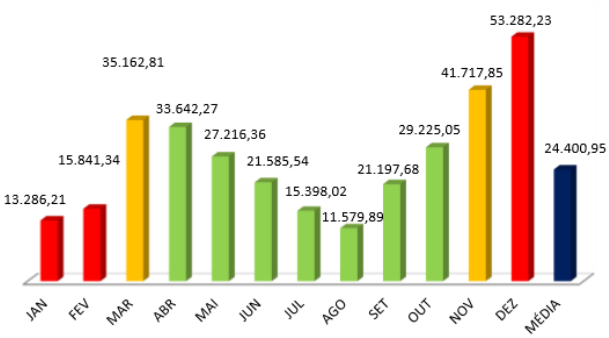

Fig. 2 Amounts paid to the local concessionaire in 2014

III. The Photovoltaic System Project

To photovoltaic system project, a 320 W photovoltaic panel with a dimension of 1.95m x 0.98m was chosen and using the manufacturer-specific data was calculate the number of plates needed to meet the demand, and it was relevant for the choice of the solar plate, the cost benefit of the plate and economic value of the same, when compared to the other plates of several powers. And the derivations show that project needs 105 solar plates with 320wh, considering the installed lighting system. To meet the demand, the panels must generate

at least 33,264 Wh supplying the whole period in which electricity is consumed, through the lighting of the sections of the establishment.

The solar panels generate electricity in CC, have two poles, one negative and one positive. In this way, they obey Ohm's Law, for calculations of the electrical system, when studied for the project. In this way, the system will be assembled by serial sequences of plates and then, with the serial plate arrangements will be connected in parallel, as shown in Figure 3. With regard to the dimensioning of the inverter, equipment that converts the electricity generated by the panels in DC to AC, suitable and equivalent to the grid, will be chosen through the electrical specifications of the solar system, for a better efficiency. The main characteristic of this equipment is the possibility of it being interconnected to the electricity grid of the power distributor, thus realizing the synchronization of frequency and output voltage. Each array, with 15 plates in series, has a current of 8.69 A, because when connected in series the current has a unique value for all plates and the total voltage is the sum of all the cells placed in series, as showed before.

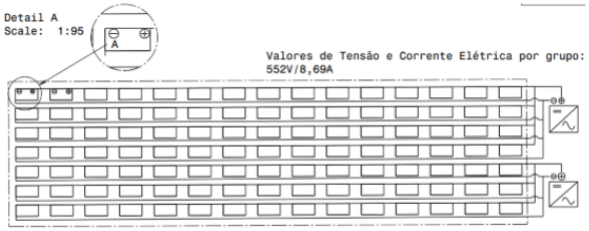

Fig. 3 Solar panels arrangements

Each circuit with 15 plates in series the voltage will be 552 V and the current equivalent to 8.6. Thus, the final system, with all 105 plates, will have voltage equivalent to 552 V, because the plates in series are in parallel with the others. However, the current will be the sum of the currents of the circuits with solar panels connected in series. The derive shows two 25 kW three-phase inverters must be considered for this study, with a nominal input voltage of 580 V and a DC current of 66.3 A.

IV. PHOTOVOLTAIC SYSTEM POWER CONSUMPTION

The derive shows that monthly income of the system can reach about 5.000.000 Wh per month, thus, the amount of energy generated is close to the average monthly consumption of illumination, it represents about 90% of the energy consumed per month. The monthly savings, using the values of monthly partial consumption, which considers only the tariff red flag level II and more the energy tariff, can reach approximately R$ 2.277,45, gross amount of electricity consumption per kWh.

V. SYSTEM PHOTOVOLTAIC SYSTEM PAY BACK

With the investment in new technologies, one has the questioning in when and how one has the payback of the invested initial value. In photovoltaic energy generation technologies, the return on the initial investment is the saving caused by investing in the photovoltaic system. However, for the calculation of the payback it is necessary to have the amount invested in the photovoltaic system, thus will be added the costs of all equipment used, cost of the investment of the system considering 25% of the values of the equipment, including the system maintenance values.

TABLE I
PHOTOVOLTAIC SYSTEM TOTAL VALUES

Equipamento	Qtde	Valor ($)	Valor (R$)	Valor Total (R$)
Placas Solares 320 W	105	$ 234,00	R$ 737,10	R$ 77.395,50
Inversor *Grid-tie*	2		R$ 22.590,97	R$ 45.181,94
Cabos, estrutura e instalação				R$ 19.348,88
Total				R$ 141.926,32

At the figure below, the time of simple payback is graphically represented, allowing the visualization of the month in which the SFV initial investment payback takes place, with 5,036.72 kWh installed per month, considering that each month there is a reduction of R $ 5,439, 65, in the monthly energy expenditure of the Mário Bonatti building.

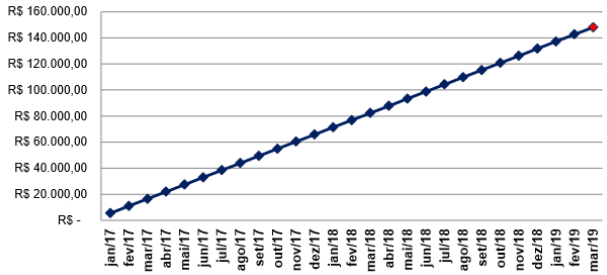

Fig. 3 Photovoltaic system simple payback

VI. CONCLUSION

Among the different ways of generating electricity, in a cleaner way, photovoltaic energy, in a grid-tie system, stands out for efficiency and effectiveness, in addition to being economically viable.

In this work, the study was carried out to analyze the economic feasibility of implementing a photovoltaic system connected to the grid, with an investment value equivalent to R$ 141,926.32, for the average monthly consumption of 5,588.352 kWh of whole lighting system of educational building Mário Bonatti, from UNISAL in Lorena, in the interior of São Paulo State. The financial analysis was done starting from the time of return of the initial investment, simple and discounted payback, considering that each month, it will have an economic of 5.036,72 kWh, equivalent to R$

5.439,65 in the total amount that is paid to local energy company.

The simple payback, which is equivalent to the time that the investor will have the return of the amount initially invested in the project, has resulted in the period of 27 months, that is, two years and three months after the installation of the system. As of the 27th month, the investor will only make profits with the photovoltaic system.

With the analysis, the values obtained by the derivation, the investment is considerable; even if lack of government incentives, all values corroborates that the investment is feasible and rewarding for the university. In addition to encouraging the use of renewable energies, with electricity generation in a cleaner way, it emphasizes the need for the country to seek new technologies and incentives in the consumer market of the Vale do Paraíba region and, among others, to use differentiated and less aggressive mechanisms. environment for the generation of energy. Besides making Brazil one of the countries of power and prominence in the use of photovoltaic energy.

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