Proceedings

Electric Power Systems from Solar Panels in Mexico †

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Abstract: A detailed analysis of the electrical consumption of a residential house in the state of Mexico was carried out, where the comparison between the diagnosed consumption and the consumption given by the Federal Electricity Commission (CFE) in charge of the regulation of electricity, in the same way, the analysis of the electricity consumption is carried out by means of solar collectors, making comparative graphics of the price and the diagnosis, looking for a benefit with respect to the electricity consumption by means of renewable energies.

Keywords: renewable energy; electric consumption; electrical diagnosis; photovoltaic systems

1. Introduction

Electric power is one of the main sources of consumption for human beings, in addition to being a service it is a basic need to be able to perform a large number of daily activities. In Mexico since 1960, the Federal Electricity Commission (CFE) has been the company responsible for the generation, transmission, distribution and commercialization of electricity consumption. There are facilities that generate electricity such as hydroelectric, carboelectric, and a nucleoelectric plant. On the part of renewable resources, geothermalelectric and eolo electric, solar energy in Mexico enters with a minimum amount in the supply of consumption [1].

When talking about clean energies Mexico has the parameters to work with them from their geographical and weather conditions, as well as their availability of wind, radiance, from the oceans, seas and rivers, to the biomes and biogas, however, these Clean energies are not exploited to a maximum or to be a crucial factor in obtaining electrical energy, only about 10% of all these energy sources are used [2,3].

1.1. Solar Radiance in Mexico

Mexico is in an optimal area when talking about solar radiance, through Solargis we can obtain a map of the existing solar radiance in Mexico, as it is noted, we have the necessary conditions to have solar collectors and thus obtain clean electric energy. When we talk about the temperature with respect to solar energy, we focus on the air temperature, Mexico has characteristics of great importance if it is desired to exploit solar energy from the heating of water to obtaining electricity [4].
1.2. Official Mexican Standard NOM-032-ENER-2013

“This official Mexican standard establishes the maximum electric power limits of electronic equipment and devices that demand standby power, in single-phase supply voltages from 100 V to 277 V in a.c. and 50 Hz or 60 Hz.” [3]. This standard was established by the National Advisory Committee for Standardization for the Preservation and Rational Use of Energy Resources, this standard is applied to electronic devices such as digital televisions, decoders with reception of signals from cable television, satellite or internet protocol, equipment for image reproduction, such as printers, scanners, copiers and multifunctional, microwave ovens, independent audio playback equipment, among others.

Our point of interest is to analyze the electricity consumption generated by a household in a certain area of the center of the country in which, with respect to the data thrown by the National Interconnected System, the demand of 7965 MW/h [5]. The state of Mexico is within the downtown area. In order to carry out this electrical diagnosis, it is essential to talk about the rules that control the electrical consumption of household appliances.

We focus on conducting an electrical diagnosis of a home for the State of Mexico where important characteristics such as existing urban development were considered, as well as the site to choose this due to the different amounts of solar radiance. Collecting electrical consumption data of each of the average household electrical appliances, as well as the electrical installation of lamps.

On the other hand, we focus on making known the benefits of photovoltaic energy through a system of solar collectors, mitigating household electricity consumption and resulting in improvement.

This electrical diagnosis will tell us if the measurement parameters that are obtained with CFE are indeed correct, otherwise those measurement errors can be diagnosed, it will also tell us those devices which consume more electrical energy, for this we will carry out a methodology, as well as the electric consumption receipts issued by CFE.

2. Methodology Used

- Each of the household appliances for electricity consumption is considered.
- The number of hours the device is in operation during the day, week, month and two-month period is considered into account.
- The corresponding calculations are made to obtain power consumption of the electronic device.
- The values obtained are compared against the values given by the Federal Electricity Commission (CFE).
- A statistical study of the energy cost is carried out, as well as a comparison of the balance of electrical energy and the actual consumption.
- The costs/benefits of the measures considered to be the most consumed are analyzed.
- The main measures of saving and/or efficient use of energy are sought.

3. Diagnostic Development

1. According to each of the household appliances, the measures of electrical consumption were taken, considered into account their power or in the case of not having this information, the amount of voltage and electric current indicated in the equipment is used.
   a. If this is the case, the waiting time in which the device is not in operation is considered.
   b. Once the power values were obtained, the hours of use of the device were taken for one day, one week, one month and two months.
   c. A calculation was made to obtain the amount of electricity consumption for bimonthly hours of each of the devices.

2. Knowing the value previously obtained from electricity consumption and the value provided by the CFE receipt, a comparison was made to verify the fidelity of our diagnosis.
3. A comparative analysis was carried out by means of a couple of graphs, the value of the electrical
consumption diagnosed against the price and the actual electricity consumption against the price respectively.

4. Taking into account the three highest values in terms of electricity consumption (KWh), the cost/benefit of each was analyzed.

5. With the three devices with the highest consumption, the main measures of saving and efficiency were sought.

4. Analysis

Balance of Electricity and Comparison with Actual Consumption

Knowing the value of the actual electric power consumption (CREE) provided by the receipts issued by the Federal Electricity Commission (CFE), we can corroborate the values previously obtained with respect to the estimated electric power consumption (CEEE). Obtaining a relative error as presented in Table 1.

| CREE Two Previous Bimesters (kW) | CREE (kW) | CEEE Bimester | % Relative Error |
|----------------------------------|-----------|---------------|-----------------|
| 260                              | 311       | 285.5         | ΣEi 280.88      | 1.619           |

Using the free platform SISIFO which can simulate a solar panel considering a photovoltaic system. For this simulation the energy production of silicon solar panels was considered during a solar year (Figure 1). It is observed that the generation of energy is on average of 12 kWh bimonthly, our demand per household is 285.5 KW, for this reason, a solar collector is enough in a home to mitigate its electricity consumption.

5. Conclusions

The charge marked by CFE is $0.793 per kWh giving a total monthly expense of $222.73, using solar collectors the total payment would be partially reduced by 25–30% of the annual expenditure, this being a more sustainable medium for obtaining electrical energy.
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