Comparison of Energy Savings Measures in Plant Fruit Storage Facility

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Abstract: *This research will analyse the utilization of photovoltaic plant in a fruit storage facility to produce electricity for running the refrigerators to keep cool the fruit preservation in the Storage Facility. The building has two sets of refrigerators with a power of 18.2 kW each. Firstly, the work analysis deals with the convenience of installing a Photovoltaic Plant to produce electricity for supplying the refrigerators. Secondly, implementing energy efficiency measures such as adding a new layer of insulation to the walls has been analysed. Result analysis shows that the return of investment by the installation of Photovoltaic plant is less convenient compared to that of a thermal insulation layer on the interior sites. In conclusion, it has been decided to implement only thermal insulation as energy efficiency measures to this facility where the saving is about 15% of electricity consumption per year. Given that the saving in one year is 3069kWh and the cost of electricity is 0.09 EUR/kWh, the savings in monetary value is 276 EUR /year.*
Keywords: *PHOTOVOLTAIC PLANT, ENERGY SAVINGS MEASURES, REFRIGERATOR, THERMAL INSULATION*

1. Introduction

In Albania, final energy consumption in building sector is equal to 30% percent of national consumption and the sector was responsible for the use of 60% of electricity, as part of final energy consumption. The service quality of electricity equipment is much lower than the European Union average [1].

Albania is a part of the Energy Community Treaty, so it is obliged to adopt EU legislation on energy efficiency. In April 2015, the country transposed Directive 2006/32 / EC on Energy Efficiency in End Users and Energy Services and Directive (ESD) 2010/30 / EU on Energy Product Labels (Former Directive 92/75 / EEC). In line with ESD, in 2018, the country should achieve energy saving targets of up to 9% of the total amount of energy sold, compared to 2010. According to the ESD, Albania should save 1.5% of the amount of energy each year sold compared to the period of the last three years, using the mandatory scheme for enterprises, or other alternative routes. Achieving these goals requires more ambitious policy and investment efforts than ever before for energy efficiency [2-4].

The main objective of this research work is the comparison of energy savings measures in plant fruit storage facility in the city of Korca (Albania). The project deals with the analysis of different energy efficient measurements and ends with the selection of most suitable one such as the implementation of thermal insulation.

2. General Description of Fruit Storage Building and Electricity Consumption Analysis

2.1 Architecture and Cooling Plant

The Fruit Storage building is located in the city of Korca (see Fig. 2.1). The building has the total area of A = 150 m^2. Building is composed only with one floor with the height of about 6 meter. The facility is mainly used for conserving apples.

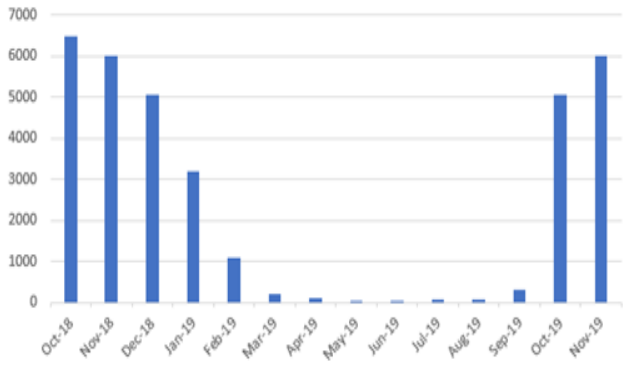
Figure 2.1 *Fruit Storage Building in Korce*

From the analysis made on the building, its architecture is composed with sheet metal cladding and a layer of thermal insulation in the middle. The building uses only electricity for running the cooling system and other electrical equipment such as lighting. Figure 2.2 presents the cooling system, and this plant is composed by two refrigerators with a power of 18.2kW each.

Figure 2.2 *Cooling Plant*

2.1 Electricity Consumption

The graphs in Figure 2.3 presents historical data on electricity consumption for each month for the years 2018 and 2019.



Months	Consumptions (kWh
Oct-18	6497
Nov-18	6013
Dec-18	5057
Jan-19	3185
Feb-19	1090
Mar-19	190
Apr-19	113
May-19	10
Jun-19	48
Jul-19	55
Aug-19	62
Sep-19	289
Oct-19	5057
Nov-19	6013

Figure 2.3 *Electricity Consumption [kWh /month]*

3. Implementation of Energy Efficiency Measures

3.1 Implementation of Photovoltaic Panels for Electricity Generation

The area that could be installed the photovoltaic panel is 300m^2. From the technical sheet is given an average electricity production of 3kW per 30m^2 panel surface. As a result for an area of 300m^2 it can be generated 30kW of electricity.

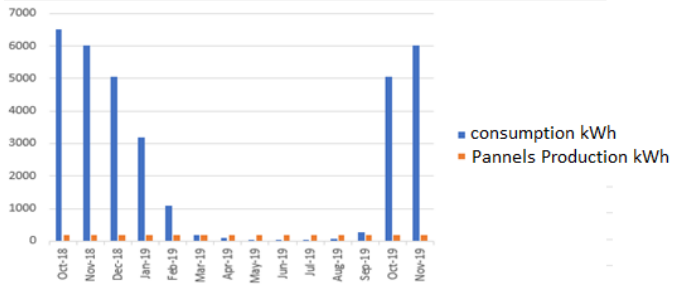


Figure 3.1 *Electricity produced versus that consumed on monthly based*

Figure 3.1 presents the electricity produced by the photovoltaic plant versus that consumed monthly for one year. From Fig 3.1 it can be shown that the photovoltaic panels can satisfy the electricity required by the facility from March to September. Throughout the remaining months, electricity produced by photovoltaic plants is about only 5% of the required energy consumed.

3.2 Calculation of Thermal Transmission Coefficient and Total Refrigeration Load

3.2.1 Existing Building

To analyze the thermal conductivities of the walls a software has been utilized called Design Builder [5]. Figure 3.2 presents external wall structure of the existing building. The wall is composed by three layers such as: sheet metal with 100mm layer, thermal insulation with 40mm thickness and 13mm aluminum layer. It has been calculated that, the value of the equivalent is transmission coefficient K = 0.760 [W/m^2 -K], while the total refrigeration load is Et = 52.39 kW. It has to be noted by the result analysis shows that the effect of the roof and floor on heat transfer is negligible compared to that of the roof and the floor.

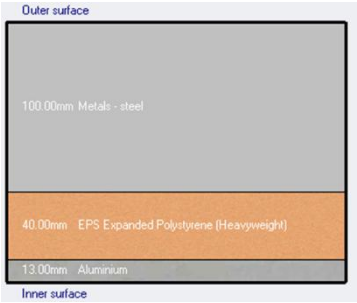


Figure 3.2 *Exterior wall structure layers [5]*

3.2.2 Improved Building

To further reduce the heat losses from the walls another insulation layer has been added such as improve the properties of the building in thermal with a thickness of 40mm. Figure 3.3 shows the improved wall composed by four layers. Results analysis from the software gives an equivalent heat transfer coefficient of 0.232 [kW/m^2 - K], which is smaller to that compared to the existing building. Finally, total cooling load is Etm = 48 kW.

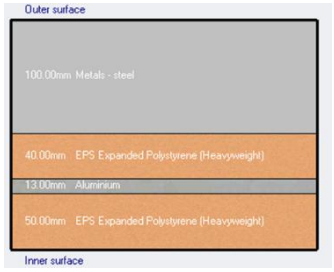


Figure 3.3 *Exterior wall structure - Improved building [5]*

3.2.3 Summary Results

Figure 3.4 presents a comparison between implementation of electricity generated by photovoltaic plant versus that by adding an insulation layer. Result analysis shows that implementation of Photovoltaic plant is less convenient compared to that by adding an insulation layer. Electricity savings is about 15% from 141.36 [kWh/m^2 year] to 122.58 [kWh/m^2 year]. Finally, the total electricity consumed: E = 18100 kWh/year. The saving in one year is 3069kWh/year. Given that the cost of electricity is 0.09 EUR/kWh, the savings in monetary value is: 3069kWh/year * 0.09EUR/kWh = 276EUR/year.

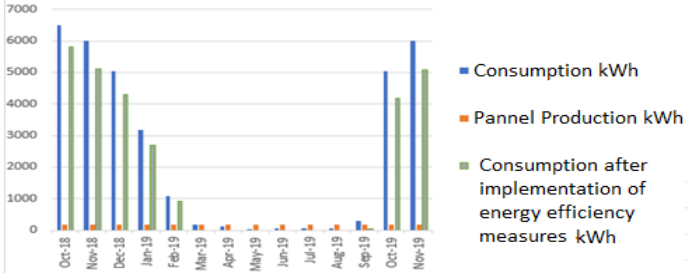


Figure 3.4 *Summary results*

4. Conclusions

In this work research the facility is analyzed to identify what is the most suitable energy efficiency measures to applied. The aim of this work research is the comparison of energy savings measures in plant fruit storage facility in the city of Korca (Albania).

The existing building has an electricity consumption of 141.36 [kWh / m^2 year]. Energy efficiency measures includes addition of a thermal insulation layer and photovoltaic plants. Results analysis is conducted by utilizing an energy software [5]. Results analysis shows that adding thermal insulation layer is much more suitable compared to that of photovoltaic plant. In conclusion, after implementing thermal insulation layer the saving of about 15% of electricity consumption per year. On yearly basis the saving 3069kWh and taking into account the cost of electricity 0.09 EUR/ kWh, the savings in monetary value is 276 EUR / year.

Finally, the methodology used in this research work can be used to analyze energy saving opportunities to other types of buildings.

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