ALTERNATIVE POWER SUPPLY SOLUTIONS TO REDUCE AIR POLLUTION WITH SUBSTANCES EMITTED BY THERMAL POWER PLANTS

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Abstract: *Economic development and living standards are correlated with an accelerated increase in energy consumption. Considering the way of electricity production in Gorj County, the main sources of air pollution are the Rovinari and Turceni Thermal Power Plants, respectively the lignite mining operations in the area's quarries. The power plants have an important contribution to the generation of dust (ash and ash deposits, traffic, fly ash dust (suspended particulate matter - aerosols, sedimentable dust) and the emission of gaseous pollutants (SOx, NOx, CO and CO2) unconvented gas and soot.With knowledge of the negative impact of pollutants on health, this paper aims to find a solution for the supply of a dwelling with non-polluting electricity, respectively with the help of a small wind turbine. Also, after setting the technical details of the required wind turbine, the cost of the installation and the period during which the investment will be amortized will be assessed..*

Key words: wind turbine, emissions, electricity, atmospheric pollution, wind.

1.Introduction

The most well-known impacts on health are related to ambient air pollution, poor water quality and poor hygiene. Knowing and determining environmental risk factors is of particular importance and is the most valuable activity for promoting and preserving the health of the population. Thermoelectric power stations that use coal as a fuel have a complex impact on all environmental factors in the surrounding area (atmosphere, water, soil, flora, fauna, etc.) that the energy sector is considered the main source of pollution.

Baskets of industrial installations are the most important sources of pollutant release in the surrounding atmosphere. Spreading them in all directions, especially rapid deviation to the ground, takes place at high wind speeds, while at low intensity movements, fine impurities from the baskets can move horizontally to long distances. Of the meteorological factors that determine the dispersion of pollutants, the wind, characterized by direction and speed, and the thermal stratification of the atmosphere are decisive. In view of the effects of air pollution on population health, irritant, fibrous, carcinogenic, teratogenic, mutagenic and indirect effects highlighted by changes in urban topoclima, flora, vegetation, on the living conditions of the population, it is proposed to supply renewable energy of a home.

2. Experimental procedure

The home chosen for the case study is Gorj County, Motru and is inhabited by three people. To ensure the house's electricity consumption and decide on the technical details of the turbines, the following information is required:

a) Daily electricity consumption of the respective dwelling;
b) Average wind speed at the location where turbines will be located.

One of the methods for determining energy consumption is to sum up the consumption of existing electronics in the home for a period of theoretical daily operation, but this method is not indicated because it does not take into account the daily routine of people living in the house. The method chosen in this case for determining household consumption is simpler, more efficient and accurate and consists of assessing the electricity consumption of the dwelling chosen in the last 12 months.

Figure 1 shows that the chosen dwelling had a daily average electricity consumption ranging from 2.38 KWh to 3.07 KWh. To ensure the required electricity production, the calculation for the turbine dimensioning will be performed to cover the maximum daily average consumption of the chosen dwelling, namely the value of 3,07KWh.

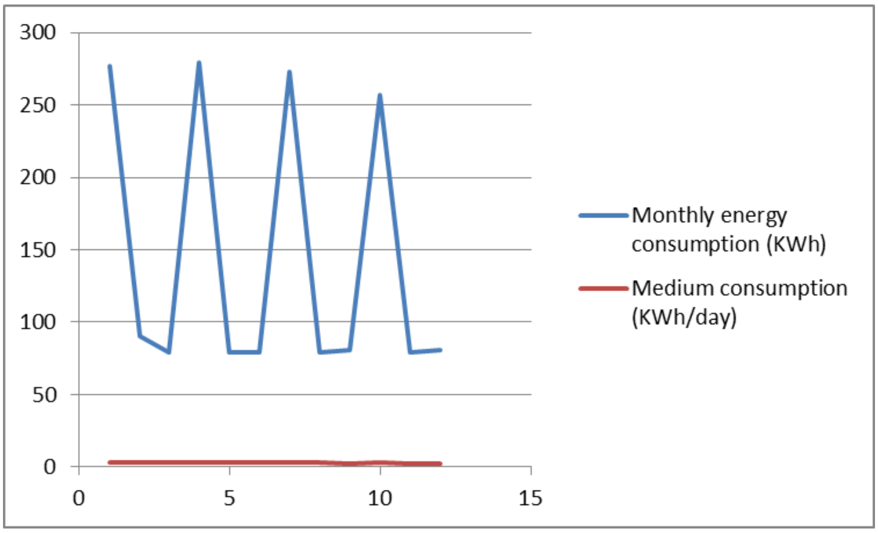

Fig.1. Power consumption invoiced by the vendor

A low power wind turbine has a 5-year warranty and life span of 7 to 10 years, and to calculate the projected consumption over 10 years, it will take into account the average electricity consumption at national level of 3 -5% annually, and the mathematical formula of compound interest will be used:

$$C_{Cz} = (1+r)^n \cdot C_{Ma} \tag{1}$$

Results and discussions:

By computing the calculations based on relation (1), on C_{Cz} we will approximate it to 5 KWh. The average annual wind speed at the chosen location is 4 to 5 m / s, which implies choosing a wind turbine capable of generating electricity at low wind speeds, namely a horizontal shaft.

Knowing the power consumption to be covered and the wind potential of the chosen area, it will be decided on the technical characteristics that would allow the wind turbine to ensure the production of the amount of electricity.

To calculate the power developed by a wind turbine, start from the equation of kinetic energy Ec of the air mass m moving at speed v:

$$Ec = (m \cdot v^2)/2 \tag{2}$$

where:

- Ec is the kinetic energy of the mass of air;

- m is the mass of air;
- v is the velocity of the air mass;

The useful energy I a wind turbine recovers from the wind energy and converts it into electricity is expressed as the product of the kinetic energy of the wind and the aerodynamic power factor of the turbine:

$$Eu= Ec \cdot Cp \quad (3)$$

where:

- I is the useful energy recovered from the kinetic energy of the wind, which the wind turbine transforms into a useful mechanical work towards the rotor axis;
- Cp is the aerodynamic power factor of the turbine, or the power factor, most often having a value of 45% for wind turbine wind turbines.

Considering a 95% turbine generator yield, 75% mechanical efficiency and knowing C_{Cz}, the amount of mechanical energy to be covered daily over 10 years, C_{Cz} = Eu·95% 75% and the mechanical energy that the turbine needs to be able to capture it to generate 5KWh of electricity per day in 8.2 hours as the wind blows at 4m / s, has the value Eu = 7.01754 KWh.

The mechanical power that the turbine must be able to capture from the kinetic energy of the wind and convert it into electrical power has a value of P = 855.79 watts and the turbine electric power is Pe = C_{Cz} / t = 609.75 watts.

The aerodynamic coefficient of turbines (Cp) is usually set for horizontal shaft turbines at about 45%, resulting Ec = 15594,53 watts.

Knowing the air density, the wind speed of 4m / s, the wind speed of 4m / s daily and the amount of kinetic energy required by the turbine, the wind turbine rotor size can be determined as D = 7.84 meters. These required rotor dimensions are very high and very high, most wind turbines for household use with a rotor of 3 to 3.5 meters. In order to obtain acceptable, easy to find, assembled and used dimensions of the rotor, it is proposed to install two wind turbines with a minimum power of 642KW. Mechanical energy must be captured in this case by two identical wind turbines of 400 watts. By making the previous calculation we obtain the diameter of each of the two turbines as D = 5.54 meters.

To sum up, replacing a single 800W wind turbine with two identical wind turbines of 400 watts is more profitable in terms of the installation price and the very large dimensions that would be required for the rotor a single turbine.

From a financial point of view, the profitability of installing a power plant for personal use with wind turbines can be evaluated during the amortization period of the investment made.

The depreciation of the investment will be made in

$$NR_l = PRt/FA_l \quad (4)$$

where:

- NR_1 is the number of months in which the investment will be depreciated;
- PRt is the total investment price of the wind turbine installed;
- F_{Al} is the value of the monthly invoice paid to the vendor prior to the installation of the wind turbine.

Taking into account the price of a wind turbine for the Motru - Gorj area and electricity bills before the turbine is installed, the number of months in which the investment can be depreciated as NR_1 = 250 months can be obtained.

3. Conclusions

In the present paper (case study) the calculation was made for the own consumption of a dwelling located in Gorj, but in most cases the decision to install a power generation system is mainly taken to obtain energy independence and financial profit.

Regarding energy independence, an observation in the case study is that the calculations for the wind turbine needed for the dwelling were made at the average values of the wind speed and the number of hours how the daily wind blows, offered by A.N.M. These values may vary from one day to the next, with the possibility that the wind does not beat at all for days at a time, and so installing its own power generation system based solely on wind energy is not recommended. The electricity supply to the dwelling must be provided by another method. The ideal way to maintain energy independence is to power the home with electricity in a wind farm - photovoltaic panels. Small wind speeds in certain areas can make the wind turbine needed to have features that are hard to implement in a real project. From the point of view of the financial profit, it can be noticed that in geographically low wind speeds the wind turbine cost is very high. Another factor that influences financial profit when installing a wind turbine to cover its own electricity consumption is the initial investment. The disadvantages of installing a wind turbine for its own energy consumption are the noise, the cost of installing the wind system and the visual appearance.

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