NON-POLLUTING POWER SUPPLY SOLUTIONS FOR HOMES

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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. Plants have their own contribution important as the generation of dust (deposits of slag and ash, traffic, dust, fly ash (powder suspended - aerosol sediment particles), and the emission of gaseous pollutants (SOx, NOx, CO and CO_2), unburnt gases and soot. Knowing the negative impact of pollutants on health, this paper aims Finding a solution supply electricity nepoluantă housing or with a small wind turbine. Also, after establishing the technical details of the required wind turbine, the plant cost is assessed and the investment period will be amortized.*

KEY WORDS: *wind turbine, emitted substances, 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 chimneys can move horizontally to long distances.

Of the meteorological factors that determine the dispersion of pollutants, decisive are the wind, characterized by direction and speed, and the thermal stratification of the atmosphere.

Taking into account the effects of air pollution on population health, ie 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 dwelling. Renewable energy is the energy obtained from inexhaustible natural resources, which are constantly regenerating at very short time intervals.

The importance of obtaining electricity from renewable sources has increased lately, especially due to the combination of two factors: increasing the total amount of electricity required and the current ways of obtaining it with harmful impact on the environment.

The predominant use of fossil fuels to generate electricity pollutes the environment with the huge amount of carbon dioxide resulting from combustion, risking an irreversible climate change.

In order to avoid the disastrous consequences of the current energy production, alternatives with less impact on the environment have been studied for obtaining energy: solar energy, wind energy, hydropower, geothermal energy and biomass.

2. EXPERIMENTAL PROCEDURE

One of the major issues directly related to the economic development and living standards of social communities is the accelerated increase in energy consumption.

Given that fossil fuel resources are diminishing, despite the identification of new extraction sources and the improvement of exploitation technologies, the study of renewable electricity production is underway.

An important potential of Romania in this field is the production of electricity using wind turbines. This paper aims to study the supply of a dwelling with electricity generated by a small wind turbine.

Wind energy is the kinetic energy of the mass of air captured by a wind turbine and used to obtain electricity.

The potential of wind energy has been discovered since antiquity, and used to navigate the ships. Subsequently, the wind was used by the windmills to grind the seeds to produce the flour.

Once discovered the method of transforming the wind force into a useful mechanical work, it was only necessary to discover the electricity and the generator to create the wind turbine and to obtain electricity with the wind as an inexhaustible primary source. The home chosen for the case study is the county of Gorj, Motru and is inhabited by three people.

To ensure the electricity consumption of the house 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 the turbines will be located.

One of the methods of determining energy consumption is to sum up the consumption of existing electronics in the home for a period of daily theoretical 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 the present case for determining the consumption of the dwelling 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. In order to ensure the necessary 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 3,07 KWh.

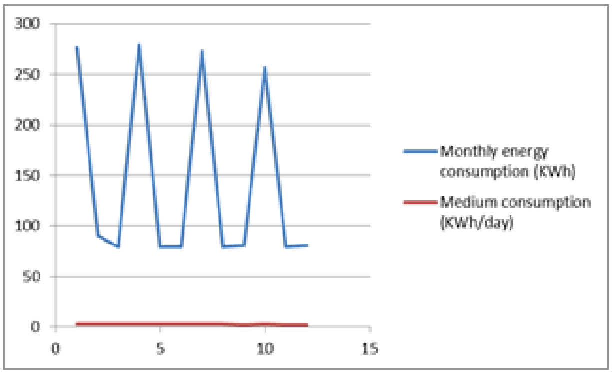

Figure 1. Power consumption invoiced by the vendor

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

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

where:

C_{Cz} represents the daily calculation, over 10 years of the chosen dwelling.

r represents the annual percentage increase in consumption, estimated at 5%, in percent;

n is the number of years for which consumption is assessed;

C_{Ma} represents the current average consumption, at 3.07 KWh.

Results and discussions

By making the calculations based on the relation (1), we will approximate to CCz at 5 KWh.

The average annual wind speed at the chosen location is 4 to 5 m / s, which implies the choice of a wind turbine capable of generating electricity at low wind speeds, namely a horizontal shaft.

Knowing the electricity 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 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:

$$Ec = (m \cdot v^2)/2 \qquad (2)$$

where:

Ec is the kinetic energy of the air mass;

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:

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

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 shaft;

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, a 75% mechanical efficiency and knowing CCz, the amount of mechanical energy to be covered daily over 10 years, CCz = Eu·95% 75% is obtained 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 capable of capturing from the kinetic energy of the wind and converting it into electrical power has a value of P = 855,79 watts and the turbine power is $Pe = C_{Cz} /t$ = 609,75 watt.

The aerodynamic coefficient of the turbines (Cp) is usually established for horizontal shaft turbines at approximately 45%, in conclusion Ec = 15594,53 watt.

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, it is possible to determine the wind turbine rotor size as D = 7,84 meters.

These required rotor dimensions are very high and very high, most wind turbines for household use having 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 minimum power 642KW.

Mechanical energy should be captured in this case by two identical wind turbines of 400 watts. Taking 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 depreciation period of the investment made.

The depreciation of the investment will be made in

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

Where:

NR_l is the number of months in which the investment will be depreciated;

PRt is the total investment price of the wind turbine installed;

FA_l 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 a NR_l = 250 month.

3. CONCLUSION

At present, electricity production is achieved in a very high percentage in the thermoelectric power plants, by the burning of fossil fuels or in nuclear power plants, by the fission of uranium atoms, polluting the environment with both greenhouse gases and greenhouse gases and radioactive waste, with nuclear fuel waste.

Against this backdrop of the alarming increase in pollution caused by electricity generation methods, the importance given to renewable energy has steadily increased over the last period.

Wind energy is one of the forms of renewable energy that has recently been sustained and encouraged at both national and global levels. The advantages of wind farms are the zero emission of pollutants and greenhouse gases, the lack of waste produced, reduced removal costs and the primary source of free energy resulting in a low energy production price.

In this paper (case study) the calculation was made for the own consumption of a dwelling situated 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 required for the dwelling were made at the average values of the wind speed and the number of hours the daily wind blows offered by A.N.M.

These values may vary from day to day, with the possibility that the wind does not beat at all for days at a time, and thus, the installation of an own electricity production system based exclusively on wind energy is not recommended.

The electricity supply of the dwelling must be provided also by another method.

The ideal way to maintain energy independence is to power the dwelling with electricity in a wind farm - photovoltaic panels.

Low wind speeds in certain areas can make the wind turbine needed to have features 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 energy consumption are the noise, the cost of installing the wind system and the visual appearance. From the point of view of the desired financial profit it can be noticed that the direct dependence between the kinetic energy of the wind and the cube of its velocity in the geographically low wind speeds causes a very long depreciation period of the wind turbine cost.

This increased cost depreciation period is primarily due to the higher power required for the turbine, as well as to the oversize of the rotor, making it impossible to obtain under normal conditions.

Another factor that influences financial profit when installing a wind turbine to cover its own electricity consumption is the initial investment. The stronger the wind potential, the higher the turbine's power and the rotor diameter will be, and therefore more expensive.

The disadvantages of installing wind turbines for their own energy consumption are the noise, the cost of installing the wind system and the visual appearance. Compared to high power wind farms located away from inhabited areas, a low-wind turbine is usually located in the yard or even on the roof, the 30 decibels produced by it at wind speeds of 5 m / s as well as the visual appearance, which can be disturbing for both the owner and the neighbors.

The cost of the initial investment may also present a major problem with the installation of a wind turbine that provides its own electricity consumption, as the individual must have the financial capacity for a fairly serious investment.

As a final conclusion, the wind turbine is a method of obtaining non-polluting electricity, relatively inexpensive as an investment and as a production price, but which, due to variation in wind speed, causes the energy produced to have unpredictable variations. In the case of low-power dwelling turbines, these variations can be countered by storing energy in the batteries.

No special construction equipment and cranes are required, and the number of approvals required to install the low power turbine drops significantly, making it much easier to install and use than high-powered turbines.

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