STREAMLINING ENERGY MANAGEMENT IN ROMANIAN SCHOOLS BY IMPLEMENTING PHOTOVOLTAIC AND SOLAR THERMAL ENERGY SYSTEMS

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Abstract

The current energy situation in most Romanian schools is unsatisfactory. Energy consumption and hence the depletion of financial resources are high due to the existence of obsolete central heating systems or to their inefficient use as well as to the upward trend in energy prices that are a threat to the budget of these schools. All these impediments can be counterbalanced by implementing renewable energy solutions in line with the strategy and policies of the European Union. In order to improve the energy management in Romanian schools, we propose the implementation of photovoltaic and solar thermal energy systems, which provide electricity and hot water.

Photovoltaic and solar thermal energy systems enable significant financial savings and even additional income, considerable energy freedom, high user comfort while protecting the environment and, therefore, are a modern solution that could be widely implemented either individually or through a national programme in Romania schools.

Keywords*: Natural resources, renewable energy, environmental protection, streamlining energy management, schools*

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1. Introduction

Based on the analysis of the existing energy situation of most schools

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in Romania and that it can be improved, in the following I will propose a solution to streamline energy management in Romanian schools. This proposal is consistent with the strategies and policies of the European Union regarding the implementation of renewable energies. I will also present the advantages of the proposed solution and the conclusions on this project.

2.1 The analysis of the existent energetical situation of most Romanian schools.

The existent energetical situation of most Romanian schools is as follows:

- The buildings are old, most of them without a proper installation, and therefore a low energy efficiency;
- The current heating systems work overwhelmingly with traditional energy resources (non-renewable) and pollutants;
- In many cases, existing heating systems have a low energy efficiency and their use results in a higher consumption of non-renewable resources (natural gas, wood, oil, etc.) and therefore higher energy costs;
- In many cases the hot water in toilets, laboratories and classrooms is missing, a situation which creates a state of discomfort for students, teachers and administrative staff;
- Although the prices of fossil resources and energy are growing in Romania, very few schools in our country have taken steps to streamline the management of energy by replacing the existing conventional heating solutions that run on fossil resources, with modern systems based on renewable energy resources;
- They have large areas on their roofs that currently are not valued and which offer the possibility of installing photovoltaic power systems and solar thermal systems;
- Few schools in Romania have used the opportunity of accessing funding sources made available by the European Union for the energetical efficiency of public institutions.

2.2. How does the photovoltaic energy and solar thermal systems work?

The functioning of the photovoltaic energy systems and of the solar thermal can be described as follows: „Photovoltaic, or solar electric panels, are used to generate electricity from the sun. They are commonly used to power homes or communities that are "off the grid", or not connected to an electric utility's power grid. Increased worldwide demand and larger scale production of panel components have cut solar panel costs by 80% over the last five years. Another emerging technology in solar electricity generation is concentrated solar power, which uses mirrors to concentrate sunlight onto receivers that collect the solar energy and heat thermal oil. That thermal energy is then used to produce electricity via a heat exchanger that vaporizes water to drive a steam turbine. Solar energy uses radiation from the sun for heating or electricity generation. "Passive" solar heating utilizes building design and construction to minimize the use of heating fuel. Passive solar design employs windows, thermal mass, and a proper insulation to enable a building itself to function as a solar collector. For example, by orienting windows to the south, the sun energy is transferred into the building through natural process of conduction, convection, and radiation. "Active" solar heating systems use pumps or fans to circulate heat (water or air) to a point of use, such as a domestic hot water tank. Solar water heaters use the sun to heat either."(http://alaskarenewableenergy.org/why-renewable-energy-is-important/alaskas-resources/solar/, 2014)

2.3. Solution for efficient energy management in Romanian schools

For streamline energy management in Romanian schools we suggest the implementation of photovoltaic energy systems and solar thermal systems which provide electricity and hot water.

The proposed solution involves the following steps:

1. Establishing the project team and assigning tasks to each team member;
2. Determination of electric and thermal energy needs for optimal maintenance of school;
3. Establishment of efficient energy management solution in accordance with the electricity and hot water necessary. Taking into account the needs of educational institutions and to achieve a optimal report effect

/ cost, it is recommended the implementation of photovoltaic and solar thermal systems;

4. The preparation of a budget for the project. Apart from setting a realistic and cautious budget, it is important to determine the amount that can be supported from their own sources (in the case of preuniversity school education by mayoralties, and in the case of universities by themselves) and the necessary of reimbursable financial resources from funding programs from the state budget, from the funding programs of other states for Romania (Norway, Switzerland, etc.), as well as from EU funding programs.
5. Writing the funding applications based on identified funding opportunities (programs for which our project meets the eligibility conditions);
6. Purchase of photovoltaic and solar thermal systems;
7. Installing the solar thermal and photovoltaic systems on the roofs of schools, location being made:
   a) in areas that the capture of sunlight is optimal (south orientation and between the sun and systems not to be interposed bodies that will cover the sunlight);
   b) distance from the locations of hot water consumption to be minimized. Choosing the best location, the investment in the network transport of hot water and heat loss will be minimal;
8. Writing the settlement of the project and necessary reports;
9. The electricity produced by photovoltaic systems will be used mainly for own consumption. The electricity excess during peak periods (when the radiation power is maximum), can be:
   - Stored with the help of a powerful battery;
   - Supplied to other schools, culture or other public institution located nearby;
   - Capitalized through the existent local distribution network through an on-grid inverter.
10. Thermal energy will be valued as follows:
    - Some will be provided as hot water in every necessary locations (bathrooms, laboratories, classrooms);
    - When the heating of school buildings is needed, the available hot water will be placed in the heating circuit (before passing through the existing heating system);

- During the period in which the heating of school buildings is unnecessary, the extra hot water can be supplied to other learning institutions, culture or other public institutions located nearby.

The advantages of the proposed solution are:

- Reduce energy costs;
- Reduce water heating costs incurred for consumption;
- Additional comfort in educational institutions that do not have hot water in every consumption place (toilets, laboratories, classrooms);
- Reduce costs with heating school buildings by introducing preheated water in the boiler;
- Additional income from the capitalization of extra electricity;
- Additional income received from the sale of green certificates for renewable energy production;
- The contribution from the point of view of environmental protection;
- The effect of learning for students through the example of solar thermal and photovoltaic systems implemented.

Regarding the possibility of placing the solar thermal and photovoltaic systems to harness sunlight as well and get the best result, we present below the classical mounted on the south-facing roof, see figure disposed on the left, and innovative alternative mounting around the outside of the round shaped building, see picture on the right.

Figure 1: Possible assembling options for photovoltaic and solar thermal systems

2.4. Renewable energy and educational institutions – a comparison Germany – Romania

In Germany, already in September 1999 it was initiated a subsidization program in renewable energy, which also provides the implementation of photovoltaic systems in schools. (Geitmann, 2005) Currently, many educational institutions in Germany dispose of a performant energy management, based on renewable energy sources.

The energy management situation in Romania is different. Romania is at the beginning in terms of implementation of some modern energy systems in educational institutions. Thus, in 2013, sector 1 Bucharest councillors approved a project which seeks at providing all public institutions in this sector with photovoltaic systems under the program „Energy Efficiency 2020", so that these institutions will dispose of electricity from renewable sources and make savings in terms of energy costs. (http://debizz.ro/1-bezirk-solarstrom-fur-alle-bildungseinrichtungen-5635/, 2013).

2.5. Energy independence – an achievable goal

An additional step is the energy independence of Romania schools. The energy independence requires much greater investments and it is much harder to achieve. An intention in this sense exists in Brasov, where according to Mr. Nandor Santa, the president of the Foundation Jules Verne, "through an

investment of 14 million euro, our school campus will include two independent buildings in terms of energy, which will host entire education cycle, from the first grade to the last class of high school." (http://www.ziare.com/mediu/panouri-fotovoltaice/o-scoala-din-romania-va-deveni-independenta-energetic-proiect-de-14-milioane-de-euro-1282596, 2014).

3. Conclusions

We believe that the implementation of photovoltaic and solar thermal systems meets the existing needs of schools in Romania. The proposed solution can be applied to all schools in Romania that do not have photovoltaic and solar thermal systems.

The issue of financing these investments can be solved by accessing the funding sources offered within the European Union programs. The energy efficiency model can be valued by the schools in Romania by following the proposed solution steps in this paper. Essential are the determination of the requirements and identifying funding sources, the writing of the financing applications and the implementing the project.

The photovoltaic and solar thermal systems provide a significant financial saving and even additional income, important energy independence and high user comfort in conditions of protecting the environment.

The implementation of this solution offers students a concrete example regarding the way an energetic system works which capitalize the renewable energy. This way, the producers of photovoltaic and solar thermal systems can promote their products in front of potential future clients and, in their turn, will provide certain facilities (discounts, free services, etc.) for the Romanian schools.

Finally, the solution of implementation of photovoltaic and solar thermal systems for as many schools in Romania brings an important contribution to environmental protection by the saving of non-renewable resources and by the substantial reduction of pollution because these solutions do not produce noxious and do not pollute phonic.

In conclusion, we can say unequivocally the implementation of photovoltaic and solar thermal systems is a modern and efficient energy management which should be implemented on a large scale, either individually or through a national program, in Romanian schools.

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