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MANAGEMENT OF A POWER SYSTEM BASED ON RENEWABLE ENERGY

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ABSTRACT

This article main purpose is to highlight the main advantage of the hardware and software implementation for an energy management system based on renewable energy sources. By using implemented and dedicated hardware and software the evolution of energy production and consumption can be monitored. The advantages of such system are highlighted by the results obtained from experimental simulations. An experimental model for the power system based on renewable energy sources was implemented, where the actual status of the system in different situations when the equipments change their own statuses can be shown.

Keywords: power system management, renewable energy, SCADA systems, energy management system, green electricity

1. Introduction

Renewable energy sources like small hydro power system, biomass, wind, solar, geothermal, and bio fuels are the future in the non conventional power energy generation systems. The importance of renewable energy sources is their contribution to green and clean energy. Renewable energy sources (RES) have a much higher degree of availability and are considered very important to improve power supply security by reducing dependence on fossil fuels to be exploited or imported, and to reduce greenhouse gas emissions, the greenhouse effect and global warming [1], [10]

The renewable energy field is rich in primary energy sources widely distributed, clean and locally available. They may come directly or indirectly from the sun as the radiant energy that includes sunshine, heat and wind energy potential.

There are three major steps to put in practice renewable energy sources to create electricity with the use of modern electric home power systems. Those three major steps are: management of primary energy sources, hardware implementation of the renewable energy based power system and monitoring by using dedicated software.

2. Primary energy sources management

Primary energy source management can be determined from the primary energy potential used to create electricity in the optimal geographical location for the desired system [1], [11].

These studies are performed on different geographical areas, analyzing the wind and solar energy potential and comparing the results in order to decide the ideal location for the solar-wind hybrid system. As a start point for renewable energy potential in Romania, two maps provided by NMA and ANAR, presenting the wind (Fig.1) and solar potential (Fig.2) can be considered.

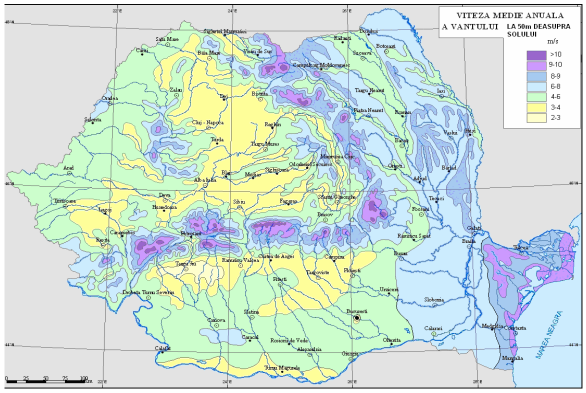

Fig. 1 – Wind energy potential of Romania [2]

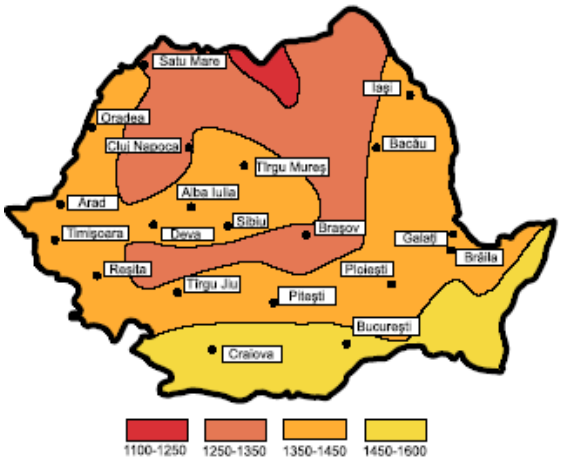

Fig. 2 – Solar energy potential of Romania [3],[9]

3. Hardware implementation of the solar-wind hybrid power system

The hardware implementation includes the power system components containing: photovoltaic solar panels, wind turbines and power electronics (grid tie synchronous power inverters, load switches and the protective relay system).

The system communication is implemented using RS-485 communication data bus. The chosen power inverters and the energy meter can be equipped with RS-485 modules and are built in monitoring units in the power inverter models, from SMA Solar Technology AG Sunny Boy [4] for the solar power system and Windy Boy [5] for the wind turbine power system.

The hardware implementation of the studied solar-wind hybrid power system is presented in Fig.3.

New technology like the SMA type power inverters were used, inverters that can produce clean electricity, can reduce the power consumption at a local energy consumer and can deliver the electricity surplus to the local grid in order to develop a much more profitable system.

4. Management of a hybrid solar-wind power system for a home consumer

The first method applied for the hybrid solar-wind power system implementation is developed in SCADA (supervisory control and data acquisition) software. This software allows the implementation of the physical hybrid power system into a graphical user interface, where electrical and non electrical parameters like the energy production and consumption, evolution or the states of the hardware equipments can be viewed [6], [7].

Software implementation of the SCADA system is presented in Fig. 4 and Fig. 5, where the permanent basis status and the alarm status of the system are shown.

Another method used for the monitoring, storage, visualization and interpretation of the received information from the local hardware equipments on the data bus to a local date server via Ethernet is represented by the authors' personal software development named *Energy management information system* [8]

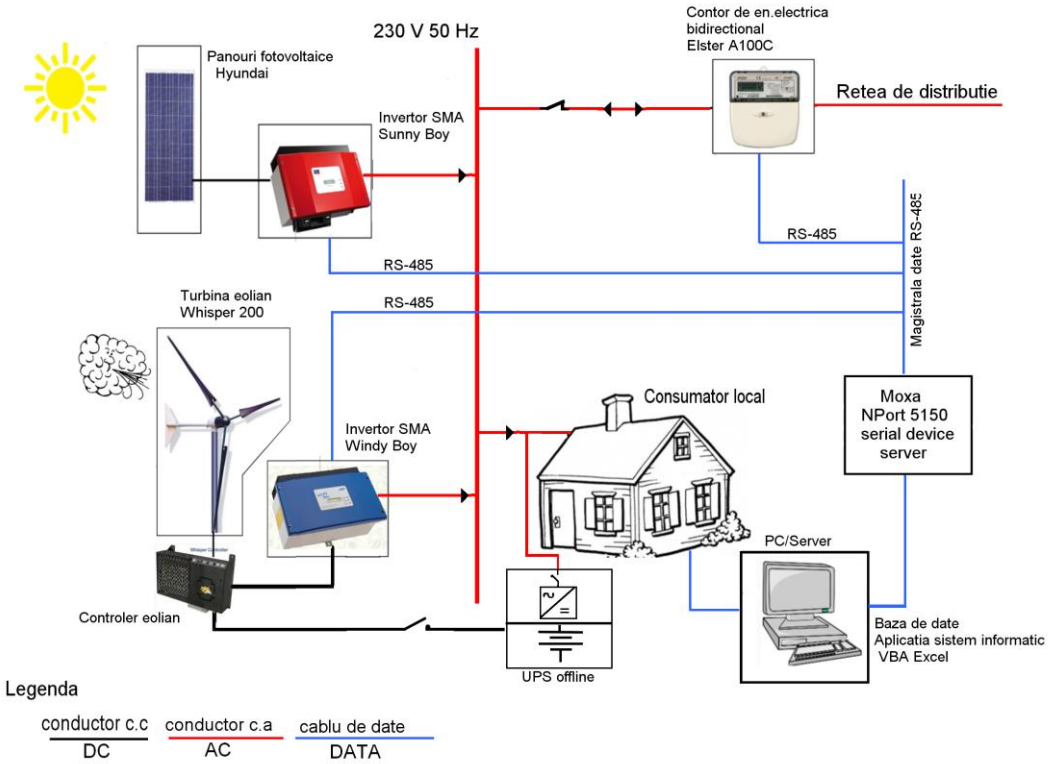

Fig. 3 – Hardware implementation of a solar-wind hybrid power system

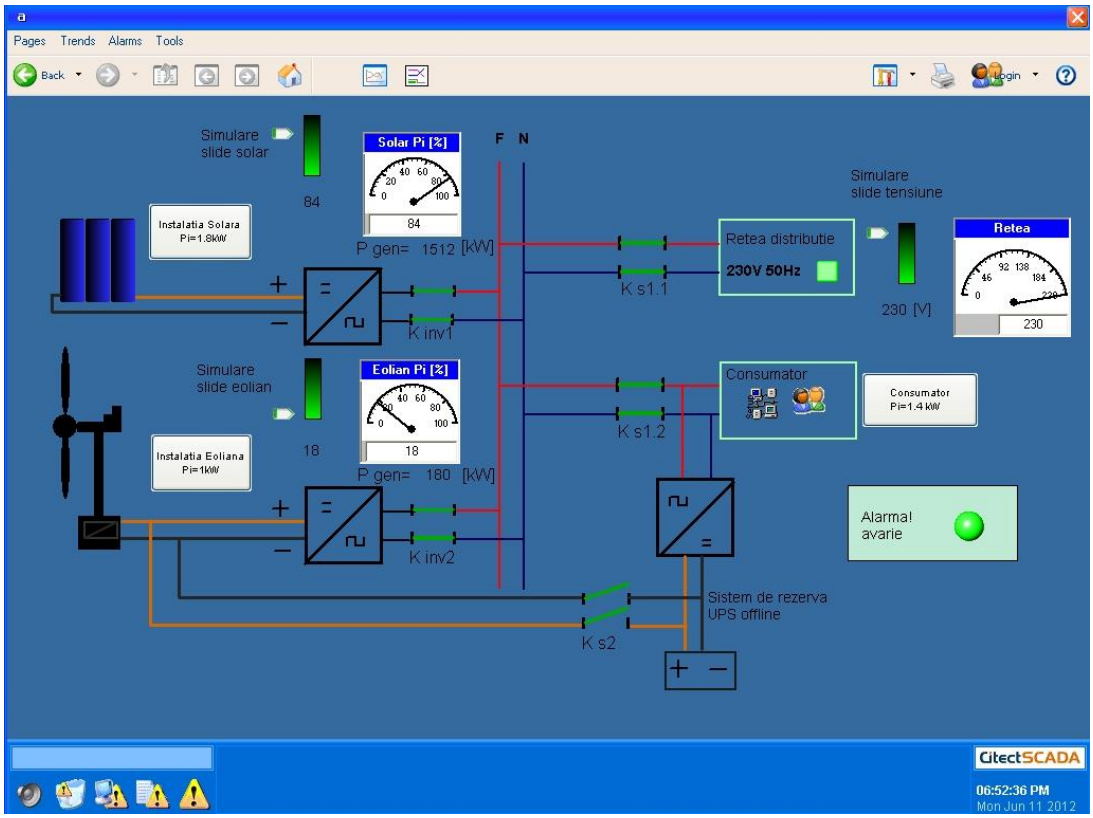

Fig. 4 – Permanent basis status of the hybrid solar-wind system implementation in SCADA

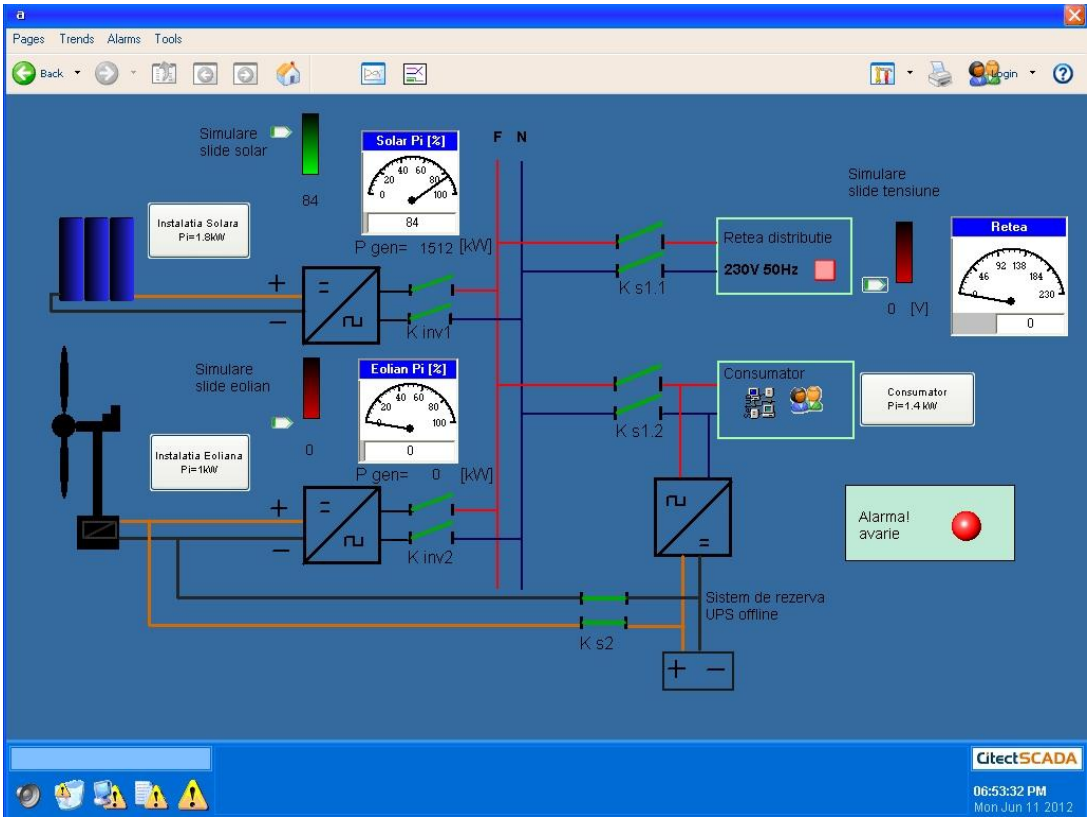

Fig. 5 – Alarm status of the hybrid solar-wind system implementation in SCADA

The software was developed in Visual Basic for Application environment and allows acquizitions about the energy production and consumption from the energy production units, information stored in tables and interpreted in different charts

Fig. 6 presents the main user interface panel.

Fig. 6 – Main user interface panel

The three menus from the main user interface panel allow the navigation to different sections of the software: consumer panel, RES system and overall system analysis.

The received data are collected and stored into a database that allows different types of tables of charts analysis such as yearly energy production from the renewable energy sources (Fig. 7) or yearly energy production from renewable energy sources units and the local consumption for a home user (Fig. 8).

Datele curente			
Luni	Productia din energie solara [kWh]	Productia din energie eoliana [kWh]	Total energie din SRE [kWh]
Ian	113	250	**363**
Feb	173	250	**423**
Mar	281	345	**626**
Apr	299	200	**499**
Mai	358	145	**503**
Iun	332	145	**477**
Iul	366	200	**566**
Aug	356	200	**556**
Sep	267	145	**412**
Okt	240	200	**440**
Nov	131	250	**381**
Dec	91.4	250	**341.4**
Total	3007.4	2580	**5587.4**

Fig. 7 – Yearly total and individual energy production from renewable energy sources as a table

5. Conclusions

The implementation of an energy management system using the new achievements from the fields of hardware and software level helps to organize and monitor the evolution of electrical parameters such as energy production and consumption. The main advantage is the efficient use of renewable energy sources that contributes to the production of green and clean electricity locally and globally and helps to

the preservation of the environment.

The development of an experimental model helps the understanding of the requirements, to predict the future needs and it is useful in the processes of developing and testing of new management and monitoring solutions.

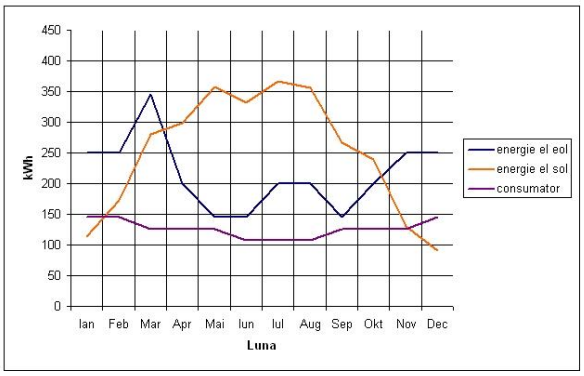

Fig. 8 – Yearly total and individual energy production from renewable energy sources and the local consumption for a home user as a chart

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