Aspects Regarding the Use of Renewable Energy in EU Countries

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Abstract: - This paper examines aspects of renewable energy use in European Union generally, and in Romania in particular, starting on existing energy resources are divided into two categories: energy resources and energy reserves. Energy reserves are known energy sources, which can be exploited in terms of economic profitability, using existing technologies. Energy resources are known energy sources, but that can be exploited in terms of economic profitability, but that could be recovered in the future if appropriate technologies are used, or if they become profitable because increase of the energy prices. At the end of the work it develops a Labview interface that allows viewing parameters of a solar panel, their evolution in time and saving the values into an Excel file.

Key-Words: Air conditioned houses, Solar energy, Solar panels, Data acquisition, Labview interface.

1 Introduction

The most important sources of energy currently used with the available technologies, are represented by fossil fuels, the most common types of fuels such as oil and products thereof, natural gas and coal. Currently, approx. 85...90 % of annual energy consumed on Earth, is produced by burning fossil fuels. In 2030, it is estimated that in terms of source used, the structure of energy production will be: 75…85 % of conventional fuel combustion, 10…20 % of nuclear fission, 3…5% of waterpower, approx. 3%of solar and wind energy. In 1975, global energy production was approx. 8.5 Twan/year, and now the level of energy production is about 10 Twan/year. For 2030, given the pace of growth population, energy production is projected to reach 22 Twan/year and given the pace of economic growth, will reach 36 Twan/year. Of these amounts, the electricity is about 18…20%, a significantly higher percentage being represented by the thermic energy [1], [3].

2 Energy Conditions Governing the Use of Renewable Energy

One of the effects of technological development of all human society, in the last century, is a strong increase of energy consumption, but increasing dependence of mankind, of the consumption of fossil fuels, particularly oil, natural gas and coal. Given the limited nature of these types of fuels, on the international plane were created a lot of organizations to study phenomena related to the evolution of consumption and reserves of fossil fuels. The most prestigious organization of its kind is The Association for the Study of Peak Oil and Gas (ASPO). This association defines itself as a network of scientists and other people category interested in the identification of the information's and the impact of scarcity of oil and natural gas. ASPO defines scarcity of oil "peak oil" as the difference between the amounts of oil extracted (production) and the amount of new oil discovered. Analog is defined natural gas deficit. In December 2005, ASPO announced that using measures to reduce consumption, i.e. productive, the oil deficit recorded in 2004 can be kept under control only over 1-2 years, but a crisis of oil and natural gas is imminent irreversible. Oil deficit is suggestive shown in Fig. 1, according to data published by ASPO in 2004. Quite significantly, after the current oil shortage, is that in November

2005, ASPO announced that in Kuwait, after six decades of intense exploitation, the most important oil field in this country and second in the world began to show obvious signs of reduction of oil reserves witch they contain [9].

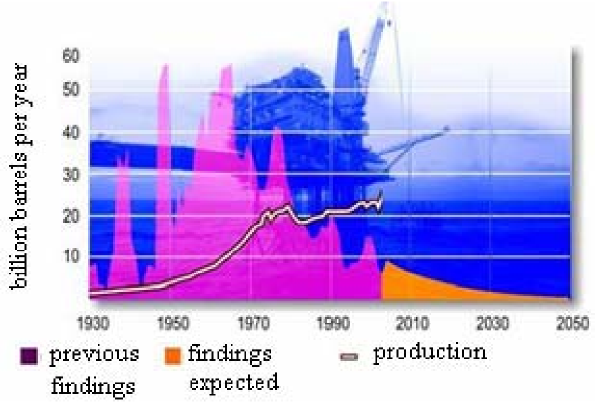


Fig. 1: Evolution of oil production and of new reserves discovered [3].

This fact was recognized by Kuwait in March 2006. In order to continue operation of the second pool of the world, was forced to reduce production from 2 million barrels a day, to only 1,7 million barrels a day, after he had abandoned an attempt to set the level of production at 1,9 million barrels per day, level which proved to be too high. Due to the current deficit for the next period is estimated a steady reduction of oil production since 2010, as shown in Fig. 2. The consumption growth in the period 2006-2010 can be explained only by the fact that is necessary to pass some time until the economy will be able to take effective measures to reduce the consumptions [13].

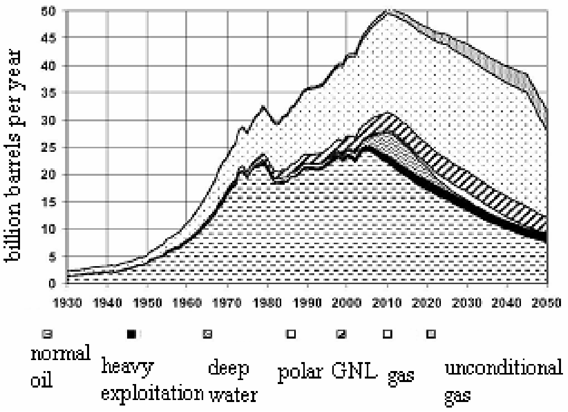


Fig. 2: The evolution of the estimated global oil production [4].

In the conditions described, appears to be explained further increase in oil production since 2004, as seen in Fig. 3. Unlike the oil crisis of the late ’70s, complete with oil prices falling, it is estimated that the current price trend is continuous and irreversible, and the impact that this price will have on the world economy, it is difficult to estimate, but will certainly be one extremely important.

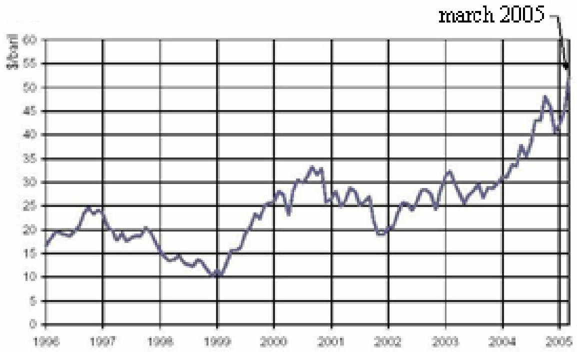


Fig. 3: The evolution of oil prices during ‘96-2005.

ASPO estimates, made in 2005, regarding the periods remaining until the depletion of fossil fuels, are presented in Tab.1.

Tab. 1: The time until the depletion of natural reserves.

Estimated period until exhaustion(years)	
Oil	45
Natural gas	66
Coal	206
Uranium	35-100

Analyzing these estimates, it is noted that very short time remaining until the exhaustion of existing resources, at least for oil and natural gas, require the finding of immediate and efficient solutions to replace of energy witch will be produced, until than using these fuels. These solutions are all more necessary as energy consumption for the world economy are growing and it is not expected a reduction of this consumption in the near future. To solve this problem, the only foreseeable solution is the use of renewable energy [11].

Another major problem, the production of energy from conventional fuels, is the high level of CO_2 emissions (Fig. 4), due process of energy production. These emissions contribute to accentuation greenhouse effect and accelerating climate change related phenomenon.

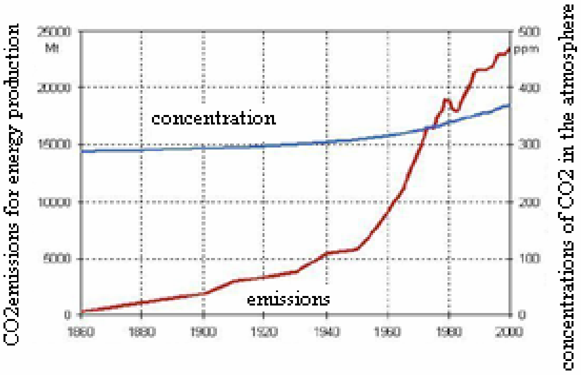


Fig. 4: The level of CO_2 emissions in the atmosphere.

Analyzing this graph, we see that from the beginning of the industrial era, until now, CO_2 emissions increased by over 30%. To justify the importance of the issue of CO_2 emissions, are shown in Fig. 5, values of natural causes damage in the period January-September 2002, and in Fig. 6, damage due to the climate change values in the period 1950-1999. It is noted that the damages caused by storms and flooding related to climate change, are much greater than the damages caused by earthquakes, or other events. It is clear that climate changes in recent years, characterized by an increased level of CO_2 emissions, caused much more damage than in periods characterized by a much lower level of pollution [7].

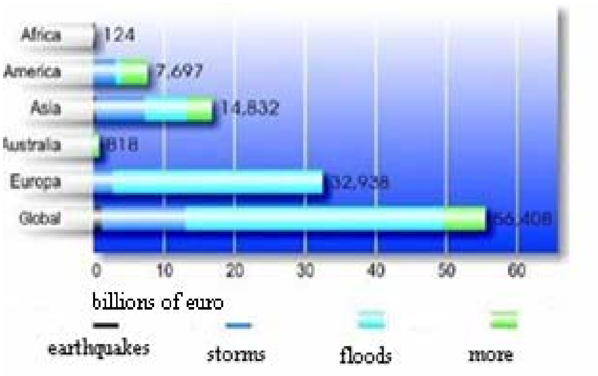


Fig. 5: The values of damage from natural causes in January-September 2002 [2].

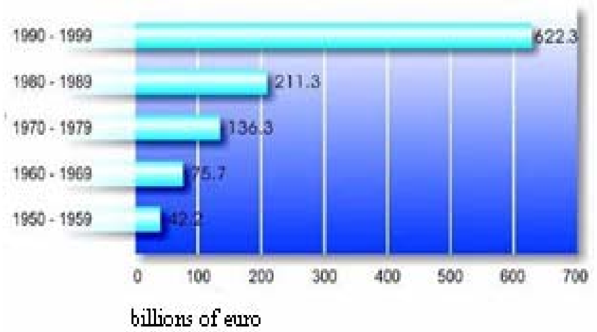


Fig. 6: The values damage due to the climate change.

Even if it does not show that CO_2 emissions are responsible for the high level of damage due to climate change, the two graphs suggests that it is possible to have a high level of correlation between CO_2 emissions and climate changes, with negative environmental impacts. One of the most efficient solutions to reduce CO_2 emissions is the use renewable energies, characterized by an extremely low level of such emissions.

3 The Types of Renewable Energy

The most common forms of renewable energy are: solar energy, geothermal energy, water energy, wind energy and biomass energy. Some of the benefits of using renewable energy are: are organic, does not use locally and are solutions for all needs. Some of the most common uses of renewable energy, together with some information's about each, are listed below:

Tab. 2: The productions of electricity for supply in the national power networks.

The form of energy	The energy source	The capacity	Countries with achievements
The wind energy	The Kinetic energy of wind	0,3…5 MW_{el} (2005)	U.S., Germany, Spain, India, etc.
The water energy	The Kinetic energy of water	5 GW_{el} - rivers 1 MW_{el} – Small dimensions	Canada, Austria, Scandinavia, etc.
The deep geothermal energy	The water or steam with high temperature	20…50 MW_{el}	Philippines, Kenya, Costa Rica, Iceland, USA, etc.
The biomass energy	The wood, the crops, the plant table	100 kW_{el} … 50 MW_{el}	Switzerland Germany, Scandinavia, etc.
The solar energy	Direct or diffuse sunlight	1 kW_{el} … some MW_{el}	Germany, Japan, Luxembourg, etc.

Tab. 3: The local production of electricity.

The form of energy	The energy source	The capacity	Countries with achievements
The solar energy *The photovoltaic panels*	The solar radiations	Some W_{el} … some kW_{el}	China, Africa, etc.
The wind energy	The low wind	0,1…80 kW_{el}	China, Mongolia, etc.
The water energy	The water potential	Some kW_{el}…25 MW_{el}	Many other countries

Tab. 4: Heating and cooling.

The form of energy	The energy source	The capacity	Countries with achievements
The solar energy *The solar panels*	The solar radiations	5…10 m^2 home >20 m^2 commercial, industrial	Germany, Japan, Greece, Turkey, etc
The geothermal	Low thermal potential	6-8 kW_{term}	Austria Germany,

surface energy			Switzerland, etc..
The deep geothermal energy	The water or steam with high temperature	2…30 kW$_{term}$	Philippines,Kenya, CostaRica, Iceland, USA, etc.
The biomass	The wood, the pellets, the crops, the plant table	2…50 kW$_{term}$ home 600kW…60 MW$_{term}$ Heating neighbourhood	Germany, Austria Canada Scandinavia, etc.

Tab. 5: Auto and shipping transport.

The form of energy	The energy source	The capacity	Countries with achievements
Bio fuels *Bio-diesel;* *Bio-ethanol*	the crops	500 t … 200000 t	Brazil Germany, France, Italy, etc.
Hydrogen	The water hydrolysis	1 kW$_{el}$ … 50 MW$_{el}$	Germany, Iceland, etc.

In all countries with notable achievements in terms of renewable, a major impact on the development of this area was the adoption of a number of regulatory incentives, including carious forms of subsidies. The market is evolving, for all types of renewable energy. In Fig. 7 to Fig. 9, are represented several graphs that illustrate the dynamics of all components of this domain, and the impact of legal regulations in Germany, the country of Europe with the largest concern in renewable energy. In all these images it is observed that, at least in Germany, renewable energy are in a real expansion, positively influenced of regulatory incentives [6], [10].

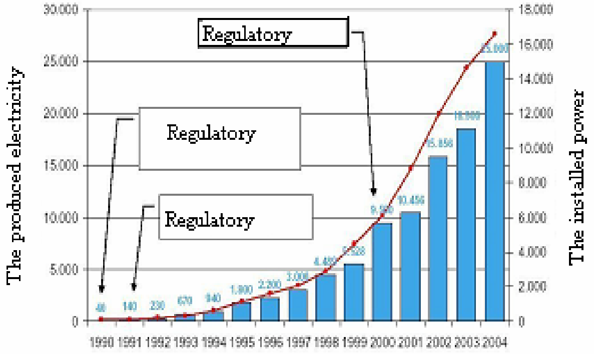


Fig.7: The evolution of wind power generation in Germany.

Such rules consist, for example, in subsidizing the price of all types of solar panels for hot water production, or acquisition by national energy company of Germany, of electricity produced by photovoltaic panels, at a price much higher than sales of electricity, for a period of up to 25 years.

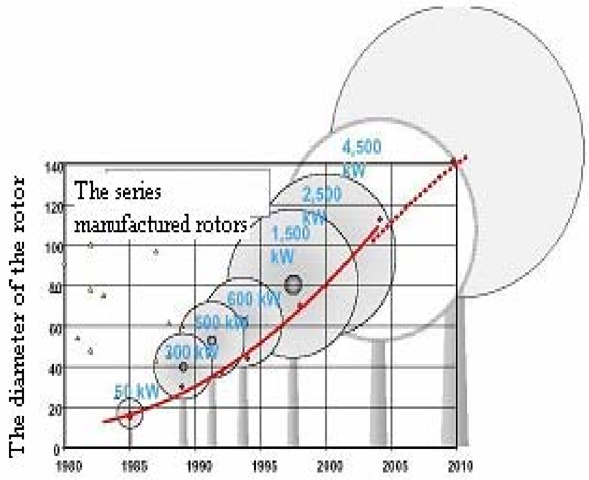


Fig. 8: The evolution of maximum diameter of the rotor wind power generators in Germany.

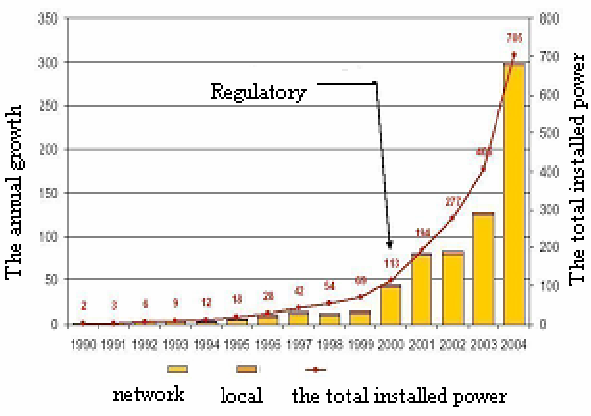


Fig. 9: The evolution of solar electricity production in Germany.

4 The Renewable Energy and Heating of the Buildings

Some of the most important features of technical systems for the production of thermal energy using the renewable resources are: need-specific solutions using thermal insulation, thermal regimes are characterized by small temperature differences and the need for the heat energy accumulation. All these features are required by the particular economic and technical conditions that must be considered at the designing heating systems for energy production using renewable energies: the conditions will be detailed below [8].

4.1 The Thermal Efficiency of Buildings

In the classic design of heating systems, are known that the use of thermal insulation has the effect of reducing of the specific fuels consumptions. Recent experience shows that, the current economic conditions, initial investment costs in thermal insulation, are written off in about 2…4 years, with corresponding reduction in fuels costs. At the design of the heating and hot water producing systems using renewable energy, the need to use thermal insulation is even more acute. It is clear that the isolation reduces heat loss and therefore reduces energy consumption, but for renewable energy use, the goal is to reduce as much as possible, the necessary of the energy witch needs to be ensured. This objective is extremely important, because the thermal energy conversion technologies of renewable energy sources are more expensive than conventional solutions. The structure of the initial costs of the investment will have two major components: a far more efficient insulation than with conventional systems, renewable energy conversion equipment, in the thermal energy. To be able to reduce equipment costs, it is mandatory to minimize the thermal load values witch will be provided by such equipments. This objective is possible only using a highly efficient thermal insulation. So, the costs of insulation will absorb quickly, and the costs of the equipments with the low heat loads, will absorb in the approx. 10-15 years, which is an absolutely reasonable time. In the conditions in witch it is expected an increase of the classics fuel prices, it may estimate that in the near future, the depreciation of equipment conversion costs of renewable in thermal energy, will be reduced accordingly. In the developed countries, there are a specific regulations regarding to the consumptions of thermal energy in which must be included the houses and there are precise procedures for energy valuation of buildings and homes. Some characteristics at certain types of mentioned homes are listed in table below (Tab. 6).

Tab. 6: The heat requirements for heating.

Characteristics	Home type		
	G95	LEH	EPH
The annual requirements of heat for heating [kWh/m^2 / year]	50	35	15
The annual requirements of heat [kWh/m^2/year]	40	35	15
The requirement of heat for cooking [kWh/m^2/year]	15	15	15
The total annual of heat requirement [kWh/m^2/ year]	105	85	45
The specific thermal load [W/m2]	50	40	20
The global heats transfer coefficients [W/m^{2}K] -Walls -Floor -Ceiling -Windows	 0,5 0,6 0,3 1,4	 0,2 0,2 0,2 1,3	 0,1 0,1 0,1 0,8

The annual thermal energy consumption of old homes in Germany, i.e. those built after the introduction of specific legislation, in Sweden or Germany, are presented in Fig. 10. For S90/G95 type homes, EPH and LEH, it can be broken analyze of the annual consumption of thermal energy, having three main components: to compensate for heat perimeter losses, for ventilation/aeration and for waste water preparation [14].

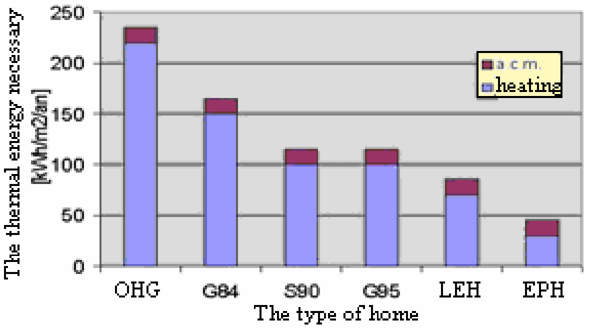


Fig.10: The evolution of annual energy consumption in homes: OHG-old houses Germany; G84-regulations Germany 1984; S90-regulations Sweden-1990; G95-regulations in Germany-1995; LEH-low energy houses; EPH-energy passive houses.

In Fig.11 is plotted annual structure of the thermal energy consumption for those types of houses:

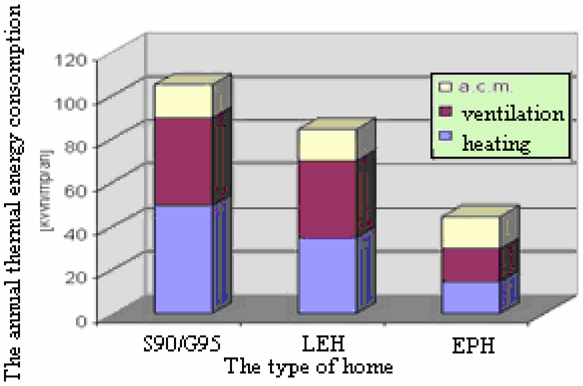


Fig. 11: The structure of the thermal energy annual consumption.

Analyzing Fig. 10 and 11, it is noted that with improved thermal performance of houses, the thermal energy consumption is reduced too. It is clear that, renewable energy will be used most effectively in low energy houses, passive houses energy respectively, because these types of buildings have the lowest energy consumption and therefore costs for renewable energy conversation equipment in the heat, will be reduced. This is a fundamental aspect, because it was already shown that prices for such equipment are high. In addition to the lowest possible costs, the investment in equipments, low energy houses and passive houses are characterized by the lowest operating costs themselves, the thermal energy bills are the lowest, and in these circumstances, it is possible relatively rapid depreciation of investments [12], [14].

4.2 Passive Energy Houses

The characteristic elements of energy passive houses are: the orientation facing south and avoidance the shady areas, a compact form and an efficient thermal insulation, efficient windows energy, the presence of a system to prevent air infiltration, avoiding thermal bridging, air freshening through ventilation and an effective system of heat recovery, the use of renewable energy sources for hot water preparation, the use of low-power appliances, the optional use of passive heating or cooling fresh air. The energy passive house concept is a concept that ensures a high thermal comfort, with low cost. This concept should not be confused with a high energy performance standard. The passive energy houses were defined as buildings where high thermal comfort conditions can be achieved by simply post-heating or post-cooling of fresh air introduced into these buildings. In this case, the air is not recycled.

The insulation of thermal energy passive houses. In Fig. 12 it is shows a detail of thermal insulation used in a passive house energy. It is noted that the insulation is placed on all outside perimeter of the building, including the roof. It should also be noted, that the insulation is placed on the outer wall of resistance to outside the building. If it may explain that the inner insulation (serious mistake that occurs frequently in insole blocks apartments in Romania), it appears the danger of condensation of moisture from the air, in the section of insulation [15].

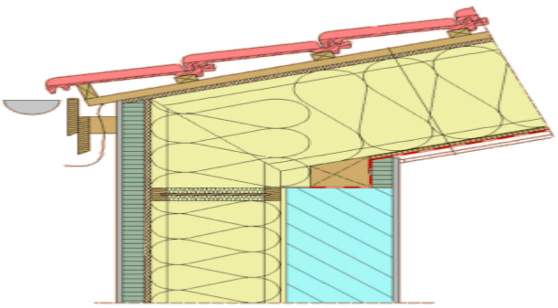


Fig. 12: A detail of thermal insulation of a passive energy houses.

The insulation of energy passive houses must be ensuring an overall heat transfer coefficient, less than 0.1 $Wm^{-2}K^{-1}$. The overall heat transfer coefficient k, is inverse of heat transfer resistance R_t. Thus, for the reduced value of ever all heat transfer coefficient corresponds a high value of thermal resistance, $R_t = k^{-1} = 10$ $[m^2KW^{-1}]$. Because between the inside and outside the building, the heat is transmitted by convection from inside the walls, by conduction, by convection inside walls and from the outside wall, thermal resistance can be calculated as the sum of partial resistance to heat transfer [5]:

$$R_t = \frac{1}{k} = \frac{1}{\alpha_i} + \sum \frac{\delta_i}{\lambda_i} + \frac{1}{\alpha_e} \qquad (1)$$

where α_i is the coefficient of convection in the interior, which depends on the speed of air flow and its temperature, having a maximum of approx. 10 $[Wm^{-2}K^{-1}]$; α_e is the outside convection coefficient, which depends on wind speed and outside air temperature, with a maximum of approx. 25 $[Wm^{-2}K^{-1}]$; δ_i is the thermal conductivity of the material it is made each layer of the wall. The medium values of thermal conductivity for some materials constituting the walls of resistance typical of the building, insulating layers respectively, are shown in Tab.7.

Tab. 7: The mean thermal conductivity.

The stuff	The thermal conductivity λ [W/mK]
Concrete	1,45
Brick	0,9
BCA	0,4
Clad wood	0,13
Wood beech/oak	0,25
Wood fir/pine	0,2
Expanded polystyrene	0,04
Extruded polystyrene	0,035
Mineral wool	0,041
Polyurethane	0,018
Cork	0,06

To better understanding the significance of overall heat transfer coefficient value of 0.1 W/m^2K, the thermal resistance of 10 m^2/W respectively, will consider the case of a wall built of bricks having 20 cm thick (one brick and a half), plated with expanded polystyrene and will calculate the necessary thickness of the layer of polystyrene, to provide thermal resistance of a passive energy house. From the previous relation it may obtain the required thickness of the layer of insulation:

$$\delta_{iz} = \lambda_{iz}\left[\frac{1}{k} - \left(\frac{1}{\alpha_i} + \frac{\delta_p}{\lambda_p} + \frac{1}{\alpha_e}\right)\right] \qquad (2)$$

Where it was considered that the wall is composed of two layers, the structure resistance denoted by the index *p* and insulation denoted by the index *iz*.

Replacing the numerical values of all quantities witch are involved, is obtain $\delta_{iz} = 0.385m \approx 40cm$.

In conclusion, for a house having a brick walls 20 inches thick, to become passive house energy, we need an insulating layer of polystyrene, 40 cm thick. If is calculates the value of the thermal resistance of same brick wall, without insulation layer, is obtained $R'_t = k'^{-1} = 0.362$ $\mathrm{m^2K\ W^{-1}}$, and the overall heat transfer coefficient *k'* is in this case $k' = R'^{-1}_t = 2.76$ [$\mathrm{Wm^{-2}K^{-1}}$]. The ratio between the thermal resistances, or between the global heat transfer coefficients in the two cases, is $R_\tau / R'_\tau = k'/k = 10/0.36 = 27.6$, so with insulation up to standard passive house energy, heat losses through walls are reduced by almost 30 times. In these circumstances, given the heat and the fact that prices are rising, it appears that the depreciation costs will be extremely rapid amortized. If the isolation of the building is achieved be a long time mortgage, basically this appropriation, together with the interest thereon, they shall be borne by the substantial savings achieved by drastically reducing heating costs. Under these conditions, the isolation will be done free of charge, with considerable improvement in the thermal comfort of the buildings. Such conclusions, fully justify the assertion that passive energy homes provides obtaining of a comfort warm with low-cost.

Windows thermally efficient. For the building of the energy passive houses, it should use the windows most energy efficient. The type of the windows depends on climate zone where building is located. In the area of Central and East Europe, in Asia area, or in northern areas, it is mandatory the use of the windows characterized by: three windows with two coatings, "Low-E" spacers "hot", made of insulating materials, insulating foam from the best quality.

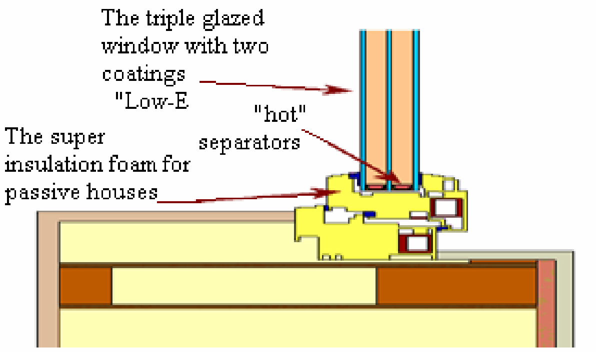


Fig.13: The constructive elements of the energy passive houses.

The constructive elements of the windows used at the passive energy homes, are shown in Fig.13, and in Fig.14 is given a window of this type. With these windows it can reach values of overall heat transfer coefficient of 0.8 W/m^{2}K, imposed to the windows for passive energy houses by European standard EN10077.

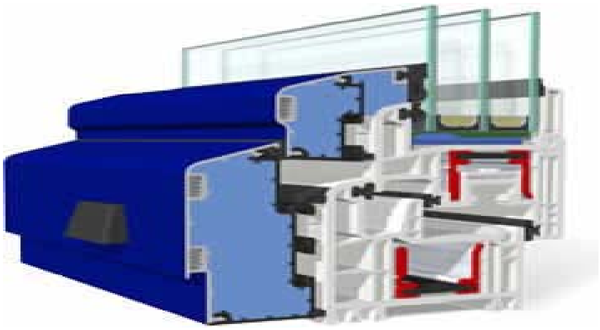


Fig. 14: A window for the passive house energy.

These windows, due to extremely low heat loss, even in the coldest days of winter, will be the value of indoor temperature over 17 °C, required to the energy passive houses, regardless of climate zone where building is located. In these conditions it is significantly improves the thermal comfort by eliminating the phenomenon of „cold radiation" of windows, a phenomenon often encountered at the buildings with low thermal performance.

5 The Using of the Photovoltaic Panels

In the last 10 years, the heating and the preparation of the domestic hot water using the solar energy, is a common option for producing thermal energy in EU countries. In the cold areas in Austria, Denmark, Norway, Sweden, Finland, etc. the solar collectors are widely used. They are cost effective even in the winter period, sun to be! Romania benefits annually for several days when the sun makes its appearance, it seems anachronistic to fail to take into account the largest supplier of natural energy. Sun's energy reserves are inexhaustible; on the sun it can not make taxes, there is not ascensions of the prices. Solar installations are used for obtaining domestic hot water, contributes to under floor heating and to heating of the water in the pool. A solar installation (Fig. 15) consists of:

- Solar collector (usually located on the roof of the house, with the face at south with an inclination of about 45°)-Solar energy trap;
- A bivalent boiler (2 coils) (positioned by usually near a thermal power station) - the storage place of the hot water;
- A cooper pipe witch make a closed circuit between the solar collector and lower coil bivalent boiler; through this pipe the pipe is circulating-the

glycol (like antifreeze) which has the property to maintain the its characteristics of a large range of temperatures(from -50 °C to +200 °C)
- The circulation pump witch put the glycol in motion;
- The automation witch acts the circulation pump according to the temperatures recorded by sensors placed in the boiler, the coller and return pipes of the circuit.

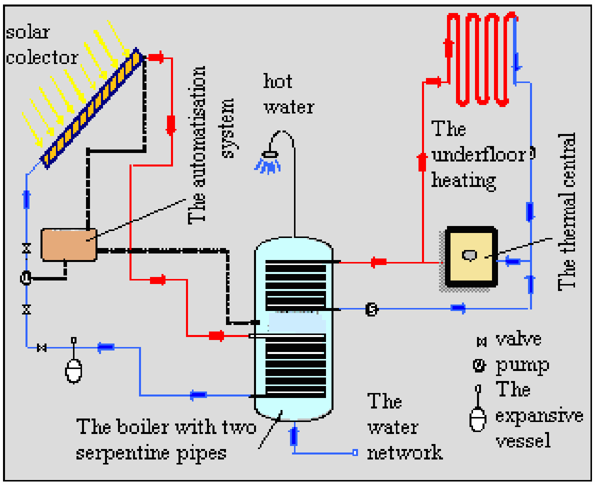


Fig. 15: The solar heating systems for domestic hot water preparation.

The latest generation of solar collectors is used as a part insulating vacuum. In the case of solar panel collectors (Fig.16), vacuum is about 10^{-3} bar, and in the case of Mazdon tubes (Fig.17) is about 10^{-8} bar vacuum.

The Mazdon vacuum tubes have the absorbent surface covered with TiNOX-the area of a 10 tubes is 1 m^2. Inside the tube there is a copper piping where the thermal agent (4g of water) is which, due to vacuum, easily vaporize [17]. The heating pipe is connected by a flexible connection to a condenser. The condenser realizes the heat exchanger with the copper pipe through which is circulating the heat that goes into the serpentine pipe tank coil solar. We have in this case a dry thermal contact, which it allows to rotate, or replace the tubes even if is a liquid and pressure in the installation. The 4g of water turns into the steam, which ascends in the capacitor where it fails the heat, condenses, etc., until the temperature from condenser reaches 130°C. At this moment, the condenser blocks the circulation of the vapours from the condenser in to the tube. The both types of collectors are used to heat the glycol. The kind of heat makes it possible to use solar collectors even in the winter time (solar panels witch directly heat the water, should be emptied when the winter comes). The two collector variants differ by the annual capture capacity of solar energy, reported on 1 m^2 (a feature that gives the quality of a solar collector), respectively [16]:
- The heliostar panel: 638 kWh/m^2/year- values for Germany and 1300-1800 kWh /m^2 /year-values for southern of Romania;
- The mazdon tube: 784 kWh/m^2/year-values for Germany or 1500 - 2000 kWh/m^2/year –values for southern of Romania.

In the solar collectors, the thermal agent (glycol) is heated to maximum temperatures of 130 – 200 ^{0}C and then down through a well-insulated copper pipes in to the lower coil of a bivalent boiler (boiler with 2 coils - the upper coil can be connected to a thermal central). The technical characteristics of high performance solar collector Heliostar are:

1. Metal case: is made of an Al-Mg alloy corrosion resistant. The case is very resistance to low pressure, which ensures the integrity of vacuum inside the collector.
2. Foil insulation lining the lower surface of the metal casing and is made of aluminium.
3. The frame is made of an *Al-Mg* alloy corrosion resistant.
4. The sealing gasket of the panel is made of temperature resistant material.
5. The absorbing wall is made of an Al - 1% Mg alloy anodized; the absorbing top surface is achieved by acquiring the galvanic coating with 8 stages Al_2O_3 with Ni black. The oven is set by pressing the collecting pipe (7).
6. The main pipes are made of cooper, with $\Phi\,22\,X1mm$ and are willing to the end of the collector, along the short sides of the metal casing (1).

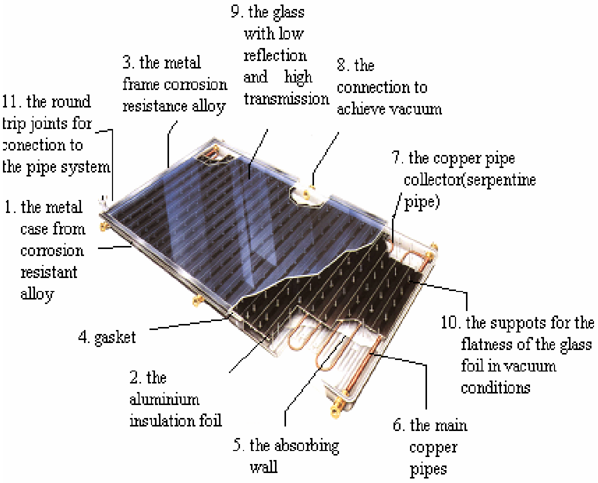


Fig. 16: A panel heliostar with vacuum [17].

7. The collector pipe is welded with the L-Ag_2P (2%Ag+P alloy) at both ends of the main pipelines and is willing in serpentine pipe for the entire length of the collector, being embedded in the absorbent wall.

8. The flagged connections for the vacuum evacuation have Φ22 mm and are situated at the halfway high side of the case. Through these connections are made both air evacuation (vacuum) and subsequent introduction of Krypton.

9. The special solar secure glass, with low reflection and very high transmission (90-91% compared with the usual glass-about 80%) does not contain iron, being perfect transparency and is tested very rigorously in terms of the mechanical resistance (to hail, mechanical shock, etc.).

Each sheet of glass is separately tested before mounting on the collector. Within more than four months of testing, were found less than 1% cases of defective solar glass sheets. The tests run in 4 separate laboratories and include mechanical, physical and chemical evidences.

10. The support elements are evenly distributed over the surface of the collector. They are resistant to high temperature and their role is to ensure the flatness of the sheet of glass in vacuum conditions (they resist at the pressure of 20.000 kg per panel).

11. The round trip flanged joints are welded Φ40mm L-Ag$_2$P at the ends of main collector pipes. These connections are provided with bushing Φ40 mm, which provides sealing and makes the connection with external piping system or interconnection panels.

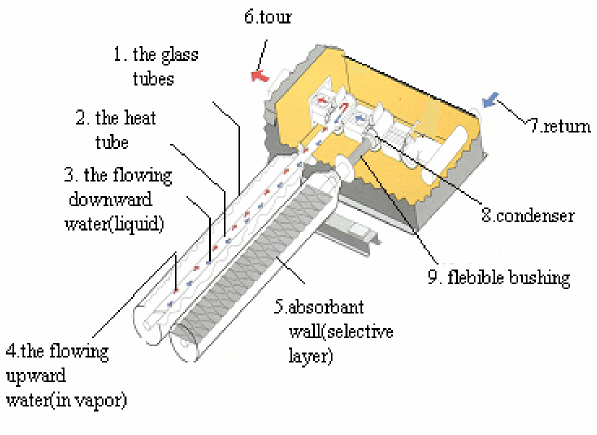


Fig. 17: The Mazdon vacuum tube.

The cold water introduced into the boiler will be heated by circulating through hot glycol serpentine pipe is flowing. In the winter time, when solar installation can not reach the desired temperature from the shower (about 42 - 43 °C), the difference temperature will be made by the central heating using of the upper serpentine pipe. The sizing of the solar installation for hot water is made starting from the number of people who use hot water in a maximum time of the day. The Mazdon system vacuum tube collector type, compared with Heliostar panel system, presents some advantages. They are:

1. The Mazdon tubes ensure a high solar energy capture (784 kWh/m^2/year-values for Germany and from 1500 to 2000 kWh/m^2/year-values for southern of Romania) and a heat recirculation flow of 270 l/hour (4.5 l/min);

2. An additional protection system of the installation, respectively the blocking of the condenser vapour transition at the temperature exceeding 130°C (other protection systems are: the expansion vessel, the automation and the pump group);

3. You can go from home peacefully in the summer time, without the installation will cause to you, problems with non-use of the hot water;

4. Easy installation on the roof;

5. The possibility of tubes swivels around the axle up to 250, so that it captures more sun light;

6. It captures the solar decreased radiation during cloudy time (we have hot water even in January);

7. The snow reflection has a positive influence to the absorption of the solar radiation, which makes these tubes to be effective in the winter months, when we have a smaller solar cover.

6 The Software Implementation

It was implemented a graphical user interface, that allows viewing and accounting of the panel solar parameters (current, voltage, lighting) and the parameters of the environment(using a thermocouple), their evolution in real time and saving values in an Excel file. The standard test conditions are: 1000 W/m², AM 1.5, T=25°C.

The real performance of a photovoltaic cell will be:

- The short-circuit current is proportional to the illumination ($i=i_{ph}$);
- The current supplied by the external circuit is about 3.2 A, for a solar radiation intensity of 1 000 W/m^2 and the order 300 mA, for a solar radiation intensity of 100 W/m^2;
- For a less sunny day, with a diffuse solar radiation, having an order of 100 W/m^2, 580 mV voltages have a value of 520 mV.

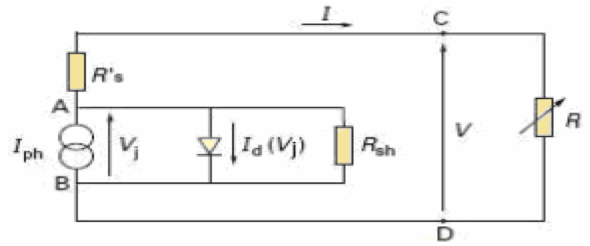
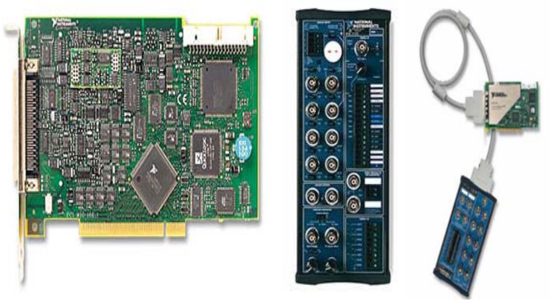


Fig. 18: The equivalent scheme of a cell.

The data acquisition is done with the illustrated modules in Fig.19, and the interface implementation program and the interface, made in Labview [18], are illustrated in Fig.20 and Fig.21.



a) b)

Fig. 19: The modulus used for data acquisition: a) PCI-MIO16E-1; b) BNC210.

7 Conclusions

Since the completion of the work is ready, we have the following conclusions:

A solar panel with a heating domestic hot water tank heats up, daily, an average amount equivalent with the tank capacity, at a temperature of 60-65°C.

In the winter months, the water temperature reaches between 15-45°C. Summer, in the sunny days, the temperature can reach over 90°C. The system is easy to assemble.

The climate changes and depletion of fossil fuels require substantial development of regenerative energies. Even skeptics have to admit that the Earth is currently in a changing climate.

With the help of the solar energy, it is offered the simplest way to stop this evolution. We are at

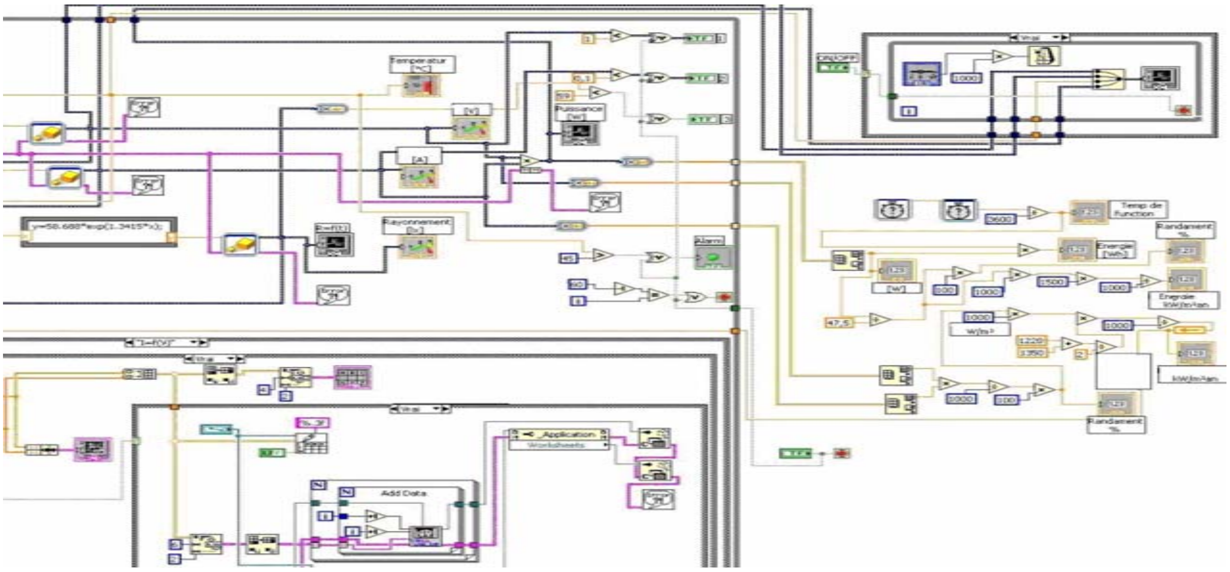


Fig. 20: The diagram of the program.

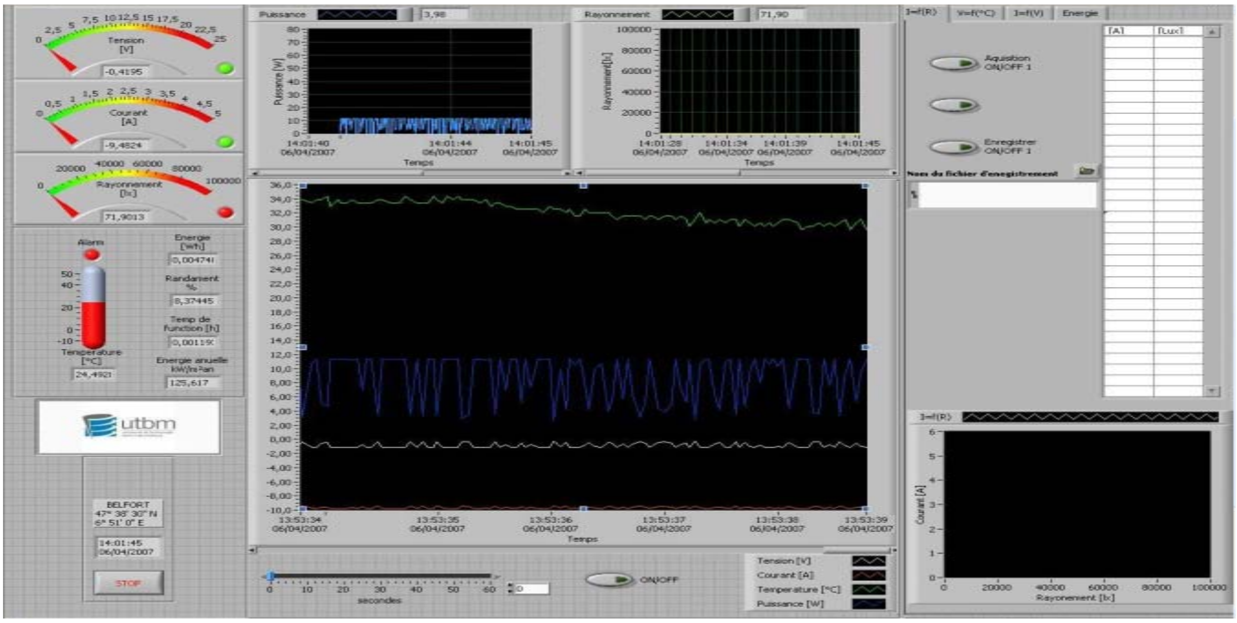


Fig. 21: The graphical interface made in Labview.

the point at which electricity consumption brings by it self a huge spending and simultaneously a reduction of the local budget for all institutions of the European Union and implicitly of Romania.

At these moments, the solution is the projects writing for the photovoltaic energy. LPA-s can access these funds for energy with costs of 2% from the project value. Romania is located in the B area of sunshine. The conclusion is that it fully deserves an investment in a solar panel.

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