Current Trends in Natural Sciences Vol. 5, Issue 9, pp. 10-17, 2016

Current Trends in Natural Sciences (on-line)
ISSN: 2284-953X
ISSN-L: 2284-9521

Current Trends in Natural Sciences (CD-Rom)
ISSN: 2284-9521
ISSN-L: 2284-9521

ECOLOGICAL COMPENSATION OF CARBON DIOXIDE FROM THE ENVIRONMENT, DUE TO THE HEATING OF BUILDINGS CASE STUDY: ENERGY EFFICIENCY AT THE FACULTY OF SCIENCES

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Abstract
The aim of this paper is to find a green way to reduce the carbon dioxide released into the environment due to the heating system for buildings. The amount of carbon dioxide is 10500 kg per year for University of Pitesti. For compensation this is necessary to plant trees around the building of Faculty of Sciences. We studied about the advantages of Paulownia trees in terms of absorption of carbon dioxide and quick-growing speed. In the first three years they reach maturity and have a height of about 20 meters. Our researches estimate that a number of 40 Paulownia trees could eliminate this pollution.

Keywords: Carbon dioxide, Paulownia trees, surface, energy efficiency.

1. INTRODUCTION

According to the Intergovernmental Group on Climate Evolution, the world can emit only 1,000 gigatons of CO_2 to block the temperature increase at 2 degrees Celsius - is "its carbon budget". Taking into account existing commitments of States, between 72 and 75% of this "budget" will be exhausted by 2030 (Chițu et al., 2013). Carbon dioxide is a colorless gas without smell and appearance, consisting of a carbon atom and two oxygen atoms having the chemical formula CO_2. Carbon dioxide is in the air (at a rate of 0.03%) and in the waters carbonated. Because the processes that produce CO_2 (burnt, fermentations, breathing, etc.) are offset of processes that take CO_2 from the air (photosynthesis), its concentration did not vary appreciably. CO_2 has a higher density than air, soluble in water, with which it is partially combine. Man and animals choke in the air with more than 30% CO_2.

Annual emissions of carbon dioxide 1.1 billion tons is due also in the proportion of 30-35% heating of rooms. Over 76% of the energy needed by a private household is used for heating (Chisăliță, 2006). About half of that is lost due to walls external cable lug or weak. About 50% of energy savings for heating may be done through thermal insulation of exterior walls (Bărbuceanu and Giosanu, 2012). Energy efficiency refers to the design and execution of construction and structures using energy and all resources as efficiently as possible (Georgescu, 2012)

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For this reason, in the context of this work, we have set out to find those ways to optimize energy consumption of the Faculty and the identification of optimal relations UPIT cost-profit making action as feasible.

2. MATERIALS AND METHODS

Construction materials used to insulate exterior of the University: expanded polystyrene, extruded polystyrene, the basaltic mineral wool, glass/door tripan, LED tubes, motion sensors-used for cost efficient the electricity. Realizing methods of study: calculation of consumption thermal and electrical energy on the one-year journey, the actual measurement of the Faculty (masonry, Windows/doors, granite), calculating the number of fluorescent tubes used by the University, making a mock of the faculty. To reduce CO_2 emissions: planting Paulownia trees.

Figure 1. University of Pitesti

3. RESULTS AND DISCUSSIONS

This case study has been undertaken for the surface of the University of Pitesti, Faculty of Science, Faculty of Mathematics. It has a total area of 2 83494 m^2, of which:
-Wall insulation foam 1214, 43 m^2;
Granite tiles for basaltic mineral wool insulation with 454,64m^2;
-Windows, doors for their replacement with tripan 1165,87 m^2.

Figure 2. Western part – UPIT

In the figure 3 is represented total UPIT surface. Wall insulated with polystyrene represent about 44 percent of the total, the windows/door area represent 40% of the total surface and granite about 16 percent of the total area.
The total area of the western part of the Faculty of Sciences is 1208,91 m^2, 423,27 m^2 of masonry (will be plated with polystyrene of 10 cm), the surface of the granite is 212,08 m^2 (will be plated with cotton wool basaltic mineral) and the surface of the glass/door represents 573,56 m^2. This surface is needed to be replaced with windows/doors tripan.
The total area of the southern part of the Faculty of Sciences is 384 m^2 – 260, 68 m^2 of masonry (will be plated with polystyrene of 10 cm), the surface of the granite is 45,2 m^2 (will be plated with

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cotton wool basaltic mineral) and the surface of the glass/door represents 7,12 m^2. This surface is needed to be replaced with windows/doors tripan.

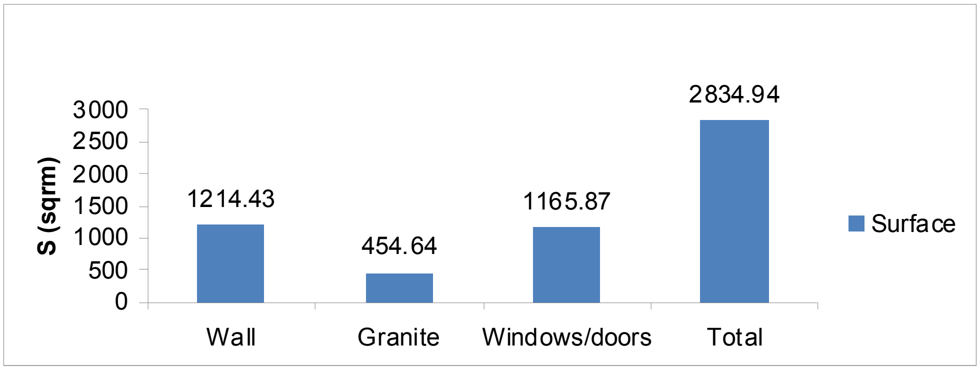

Figure 3. Total surface – University of Pitesti

The total area of the eastern part of the Faculty of Sciences is 1015, 23 m^2 – 477, 91 m^2 of masonry (will be plated with polystyrene of 10 cm), the surface of the granite is 119,28 m^2 (will be plated with cotton wool basaltic mineral) and the surface of the glass/door represents 418,04 m^2. This surface is needed to be replaced with windows/doors tripan.

Figure 4. Southern part – UPIT

The total area of the northern part of the Faculty of Sciences is 226, 8 m2 – 52, 57 m^2 of masonry (plated with polystyrene of 10 cm), the surface of the granite is 78, 08 m^2, (will be plated with cotton wool basaltic mineral) (Marinescu, 2010). The surface of the glass/door represents 96, 15 m^2. This surface will be replaced with windows/doors tripan. (Giosanu et al., 2013).
In the next stage of our work, we compared the consumption of electricity, for every month of the year 2015, in the building of the Faculty of Sciences from University of Pitesti.
From the table 1, it remarks a low consumption of electricity in the months of January, April, July, August and September, which correspond to periods of University holiday. Otherwise it can be seen that the average consumption is quite high, which justifies the choice of alternative methods for lighting.
In terms of thermal energy consumption, it can be seen (from table 2), that in months: June, July, August and September the consumption is lowest, justified by the structure of the academic year. The reduction of heat consumption with more than 30 percent would help streamline of the premises concerned. This is possible by increasing the thermal isolation of the building.

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The savings resulting from the thermal isolation of the building would allow the depreciation of costs associated with the completion of the investment. In addition, it will increase the level of thermal comfort in the institution. A reduction of 30% of the costs would lead to a saving of 72 615, 93 RON per year.

Figure 5. Eastern part – UPIT

Figure 6. Northern part – UPIT

Table 1. Electricity consumer in 2015

ELECTRICITY 2015		
MONTH	CONSUMER (KWH)	VALUE (WITHOUT VAT) RON
JANUARY	424.62	284.49
FEBRUARY	8754.86	5865.76
MARCH	8762.25	5870.71
APRIL	6606.52	4426.37
MAY	7683.41	5147.89
JUNE	7416.32	4968.94
JULY	5812.68	3894.50
AUGUST	5233.73	3506.60
SEPTEMBER	6128.95	4106.40
OCTOBER	9454	6334.18
NOVEMBER	10158.80	6806.40
DECEMBER	8827.01	5914.10
TOTAL	85 263.15	57 126.34

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Table 2. Thermal energy 2015

THERMAL ENERGY 2015		
MONTH	CONSUMER (GCAL)	VALUE (WITHOUT VAT) RON
JANUARY	96.04	38382.72
FEBRUARY	82.19	32847.69
MARCH	81.75	32668.61
APRIL	74.47	29760.01
MAY	19.37	7742.60
JUNE	0.16	62.52
JULY	0.12	32.86
AUGUST	0.08	30.50
SEPTEMBER	0.14	48.40
OCTOBER	72.46	28960.10
NOVEMBER	85.44	34160.40
DECEMBER	93.48	37356.75
TOTAL	605.7	242 053.10

From the figure 7, it can be seen that the cost for thermal energy used in Faculty of Sciences represented 81% from total cost. For this reason, is necessary to identify methods for the reduction of the energy consumption. In this way, the Faculty of Sciences building becomes a sustainable structure.

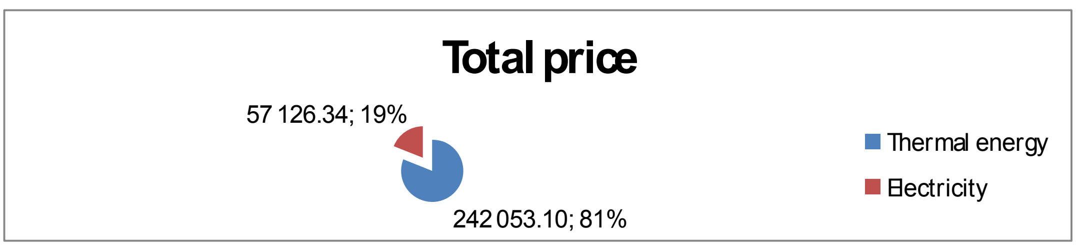

Figure 7. Total price-thermal energy and electricity

In the figure 8 is represented the number of neon tubes used in Faculty of Sciences. We consider necessary to replace them with LED tubes. They are more environmentally friendly and their maintenance and replace are not expensive, because the infrastructure is the same.

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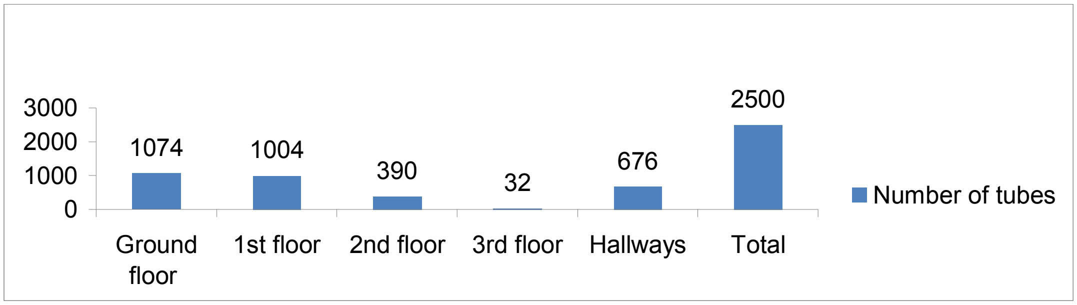

Figure 8. Total number of LED tubes

Considering that are needed on a number of LED tubes of 2500, 60 cm and an average cost of 16 RON per piece, the total cost would amount to 2500 * 16RON/pcs = 40 000 RON. The price may seem high but considering reducing consumption (%) and the life of their conclusion that investing in equipping premises with LEDs is cost effective. In addition, a part of these tubes are activated by motion sensors.

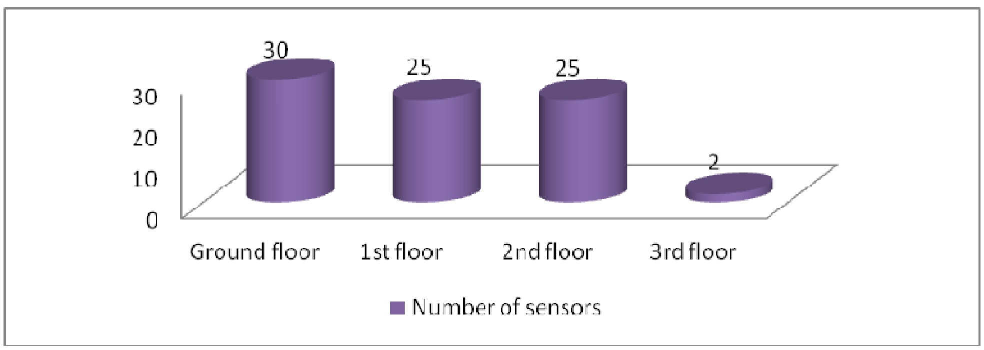

Figure 9. Total number of motion sensors

In the figure above is represented the total number of motion sensors. We need 82 sensors, 360 degrees and with a motion detector from 6 m. Price of a sensor is 30 RON/pcs, so the result is a total cost of 2 460 RON.

Another aim of this paper was to find a *green way* for the compensation of carbon dioxide from the environment, due to the heating of buildings. The Faculty is heated by a heating gas 98 kW. This emanate in nature approximately 10 500 kg/years of CO_2. To reduce this consumption is recommended to plant Paulownia trees. The CO_2 absorption by Paulownia is estimated at 1200 t/ha per year (http://www.paulowniagreene.ro/paulownia-2/paulownia-contevisa-2), which means, a number of 53 trees necessary to reduce the carbon dioxide emanated. In addition, they produce 8,000 kg/year of oxygen, so it possible to reduce the number of trees to 40.

Paulownia is a deciduous tree, with wide crown, thick stems, large leaves and fragrant flowers (figure 11). Inflorescences are formed from autumn and bloom in May-June. The fruits are capsules 3-4 cm, very decorative. Unlike other quick-growing trees that have a short lifespan, Paulownia tree can resist for 80 to 100 years. Paulownia has a very high rate of growth in favourable conditions and a short spin cycle. These trees can adapt almost any soil, having a rate of growth and size in just 3-5 years, that other tree species could touching in 25 years (http://www.paulowniaeuropa.ro/index.html). Paulownia trees can grow in the early years about 2-3 metres per year. The price of a tree 20-40 cm is 12.25 RON/piece.

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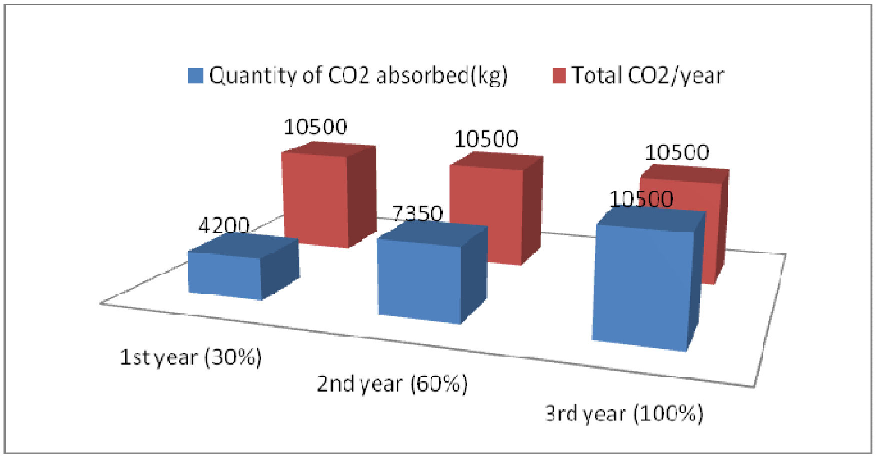

Figure 10. Quantity of CO_2 absorbed by the Paulownia trees

Figure 11. Paulownia tree in the first year (original)

In the next table is presented the cost for expanded polystyrene, extruded polystyrene, mineral wool, led tubes, motion sensors and Paulownia trees. The total cost for modernization is 307942, 214 RON.

Table 3. Materials costs of modernization

Expanded Polystyrene	**Extruded Polystyrene**	**Glazing/doors Tripan**	Led tubes	Motion Sensors	Paulownia trees	Mineral wood	Adhesives
14 RON/m^2	23 RON/m^2	202.5RON/ m^2	10 RON/pcs	30 RON/ m^2	12. 25 RON/pcs	19 RON/m^2	1.35 RON/m^2
1150 m^2	64.43 m^2	1165.8 m^2	2500 pcs	82 pcs	40 pcs	456.64 m^2	1669.07 m^2
16 100 RON	148.89 RON	236 088,675 RON	25 000 RON	2460 RON	490 RON	8638.16 RON	6 506.589 RON

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Taking into account the expenses and the incomes due to the transformation of Faculty building into a sustainable construction, we can appreciate the ratio between investment and reducing costs (30% per year).

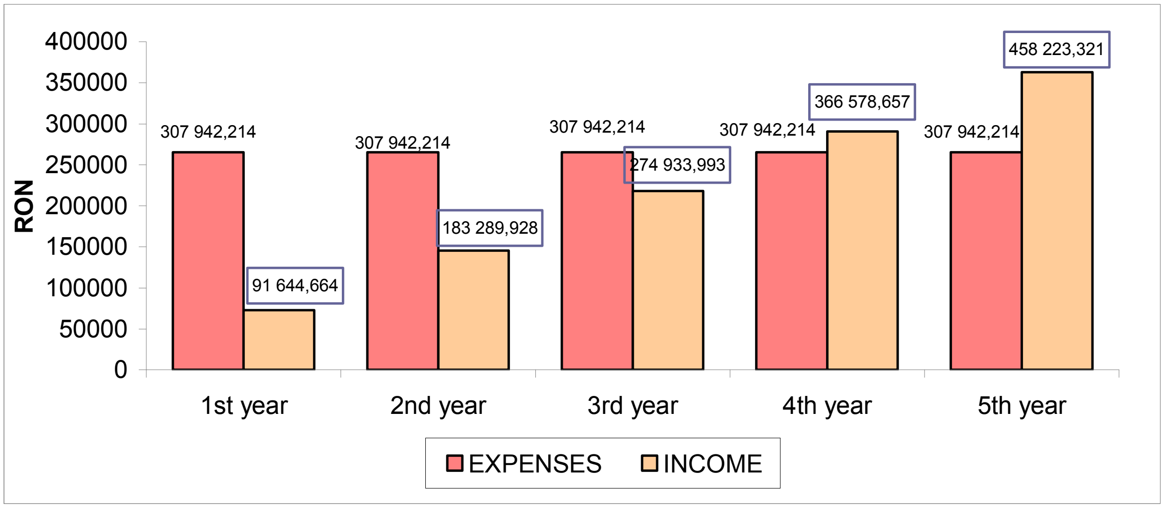

Figure 12. The ratio between expenses and reducing costs

It can be seen from figure 12, that already from the fourth year the investment recorded a net profit of 58 146, 443 RON, implying a real advantage.

4. CONCLUSIONS

The thermal isolation of the University of Pitesti, presents a number of advantages, including the reduction of thermal energy and electrical costs, but also the protection from effects of variation of temperature upon structural elements of building.

The planting of Paulownia trees around the buildings of Faculty of Sciences represents an ecological way to compensate the carbon dioxide from the environment, due to the heating of buildings. In addition, by cutting branches of these trees can be obtained biomass used for energy production. And last but not least, the Faculty of Sciences building becomes a sustainable structure.

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